MARCH

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Gold Foil—*Ferrier*
Gnathodynamics—*Klaffenbach*
Increase in Size of Crown—*Kronfeld*
Nitrous Oxide-Oxygen Anesthesia—*Beckwith*
Carbohydrate Degradation and Caries—*Fosdick & Hansen*
Uranoplasty—*Schultz*
Eskimo and Indian Field Studies—*Price*
Fulminating Osteomyelitis—*Field & Ackerman*
Artificial Denture Problem—*Pryor*
Fixed Partial Restorations—*Selberg*
Surgical Preparation for Dentures—*Suddarth*
Center of Population of Dental Education—*Eells*

EDITORIALS
Hartman Obtundent—Mail Order Racket

COUNCIL ON DENTAL THERAPEUTICS
Shotgun Vitamin Therapy

BUREAU OF PUBLIC RELATIONS
Community Health Program—*Morris*

DENTAL ECONOMICS
Physician and Dental Education—*McLester*

CONTENTS

Homer B. Robison, D.D.S. ..... Frontispiece

ORIGINAL COMMUNICATIONS

Treatment of Cavities in the Anterior Teeth and Pit and Fissure Cavities in the Posterior Teeth with Gold Foil.
By Walden I. Ferrier, D.M.D., F.A.C.D. 355

Gnathodynamics.
By Arthur O. Klaffenbach, D.D.S. 371

Increase in Size of the Clinical Crown of Human Teeth with Advancing Age.
By Rudolf Kronfeld, B.S., M.D., D.D.S. 382

Prolonged Modified Nitrous Oxide-Oxygen Anesthesia; Psychologic and Technical Factors in Its Successful Application in Major Oral Surgery.
By J. Holden Beckwith, D.D.S. 393

Theoretical Considerations of Carbohydrate Degradation in Relation to Dental Caries.
By Leonard S. Fosdick, Ph.D., and Harold L. Hansen, Ph.D. 401

Radical Uranoplasty (Limberg): A New Operation for Closure of a Cleft Palate.
By Louis Schultz, D.D.S., M.D. 407

Multiple Chondroma: Report of Case.
By L. P. Henneberger, D.D.S., and L. W. Bimestefer, D.D.S. 416

Eskimo and Indian Field Studies in Alaska and Canada.
By Weston A. Price, D.D.S., M.S., F.A.C.D. 417

Neoplastic Jaw Diseases: Carcinoma of Maxilla: Report of Case.
By Conrad C. Gilkison, D.D.S. 437

Necessity for Endocrine Treatment in Successful Prosthesis.
By Melvin E. Page, D.D.S. 439

Fulminating Osteomyelitis of the Mandible with Pathologic Fracture.
By Harry J. Field, D.D.S., and Alfred A. Ackerman, A.B., B.Sc., D.D.S. 448

Artificial Denture Problem, Past and Present; Need of Research in the Immediate Future.
By W. J. Pryor, D.D.S. 451

Modern Fixed Partial Restorations.
By Alver Selberg, D.D.S. 460

Surgical Preparation of the Mouth for the Reception of Artificial Dentures.
By C. S. Suddarth, B.S., M.D., D.D.S. 468

The Center of Population of Dental Education, 1870-1930.
By Walter Crosby Eells 473

Angioneurotic Edema of Lower Jaw: Report of Case.
By J. Leo Epstein, D.D.S., and A. Edward Gindea, D.D.S. 477

Dentistry and Tuberculosis.
By Leonard P. Wahl, D.D.S. 478

EDITORIAL DEPARTMENT

The Hartman Obtundent.—Legislative History of the Dental Corps of the Navy.—The Mail Order Racket 480-486

Obituary: Wallace Seccombe, L.D.S., D.D.S. (1878-1936) 486

Practice in Paragraphs 488

COUNCIL ON DENTAL THERAPEUTICS

Accepted Dental Remedies 490

Shotgun Vitamin Therapy 491

BUREAU OF PUBLIC RELATIONS

Community Health Program.
By Emory W. Morris, D.D.S. 495

Covered Wagon Council Health Record 501

Dedicated to Dental Health 501

Guggenheim Dental Clinic 501

Obnoxious Radio Advertising Canceled 502

DENTAL ECONOMICS

The Physician Looks at Dental Education.
By James S. McLester, M.D. 503

Medicine and Social Changes.
By R. G. Leland, M.D. 506

CURRENT LITERATURE

Abstracts 508

Abstracting Group, A.D.A. 512

MISCELLANY

Book Reviews 513

Correspondence 514

Synthetic Resin Used for Dental Gum in Germany 514

1935 Membership Record 515

Junior Membership, A.D.A. 515

News 516

Announcements 517

LIBRARY BUREAU

Recent Books Worth Borrowing or Buying 522

ADVERTISEMENTS

Index to Advertisements A-45

Classified Section A-36

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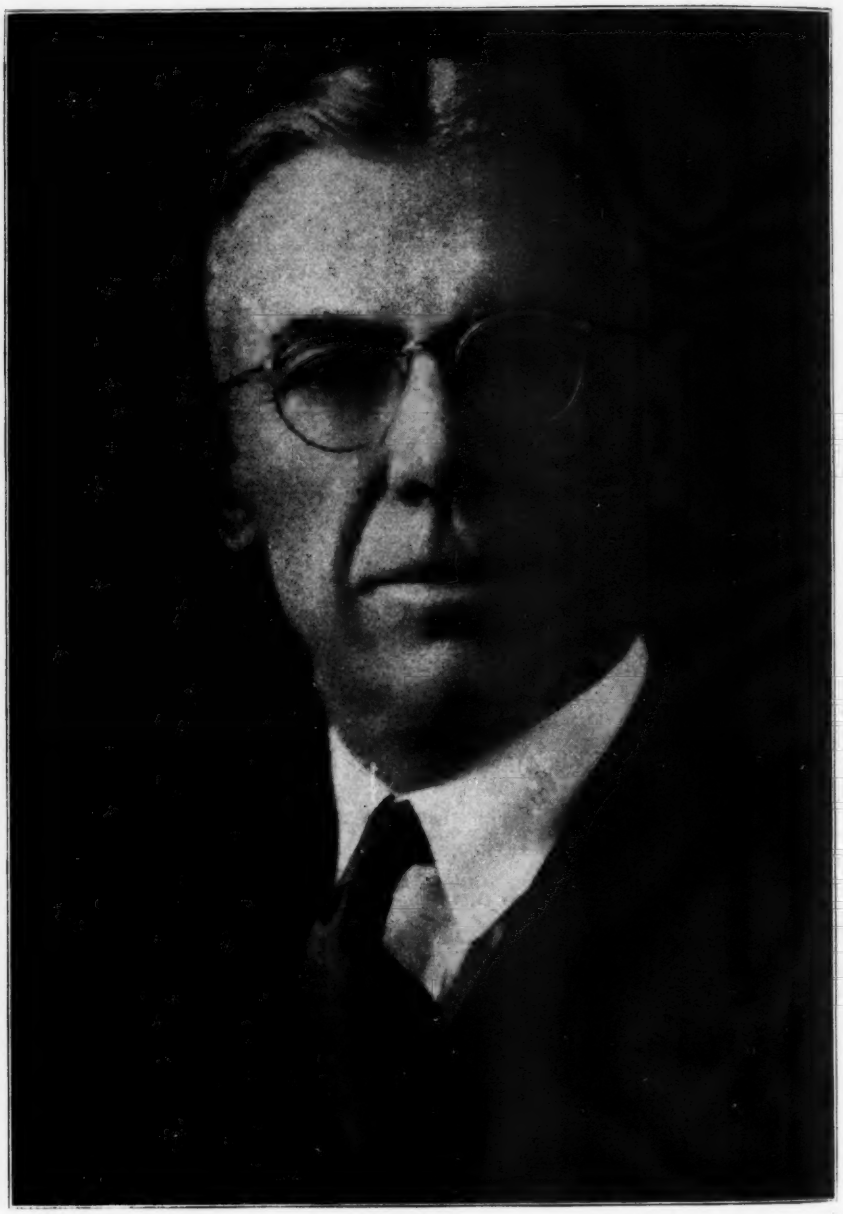

HOMER B. ROBISON, D.D.S., Hutchinson, Kan.
Vice President of the American Dental Association

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Original Communications

TREATMENT OF CAVITIES IN THE ANTERIOR TEETH AND PIT AND FISSURE CAVITIES IN THE POSTERIOR TEETH WITH GOLD FOIL*

By WALDEN I. FERRIER, D.M.D., F.A.C.D., Seattle, Wash.

THE treatment of proximal cavities in the anterior teeth requires a most exacting technic regardless of the filling material that may be indicated.

The carious area to be restored is comparatively small and difficult of access. It is triangular, the apex terminating between two rather fragile plates of enamel supported by a minimum amount of dentin in which to secure anchorage. Frequently, and more frequently since the introduction of silicate cements, with the third or lingual wall entirely broken down, a greatly weakened incisal angle is left on which the operator must depend for strength to form one point of anchorage to stabilize the operation. The base of the triangle, or gingival wall, forming the remaining and principal area of anchorage, is fortunately in a sufficient amount of dentin to afford resistance to dislodgment, and the restoration and cure of the diseased surface are made possible. To add to the difficulties, the area to be restored is closely hemmed in and guarded from approach by its approximating neighbor on one side and the vital organ of the tooth on the other side.

Considering these difficulties, and urged on by the exacting demands of an uninformed public for a restoration that harmonizes with the tooth structure in hue, is it any wonder that the great majority of our profession have turned to the use of a plastic that, for a short time, harmonizes with its surroundings, masquerading usually under a false name on its way to the final destruction of the pulp organ, if its use is persisted in?

The occurrence of cavities in the proximal surfaces of anterior teeth is perhaps more common than is recognized. I have not exact data, but the following will

*Read before the Section on Operative Dentistry at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

give some statistical authority for the presumption that these cavities are to be classified as those that most frequently occur. To determine the frequency of occurrence of eroded areas in the human teeth four years ago, I requested a study club of twelve men with whom I have been associated for a number of years to compile data on their gold foil operations for the past ten years. The results gave me a good basis on which to make an estimate, as these men use gold foil in the restoration of nearly all eroded areas on the gingival third of teeth. The same compilation will serve to give a somewhat less accurate estimate of the percentage of cavities that occur on the proximal surfaces of anterior teeth as compared with the percentage that occur on the other surfaces of the teeth.

Fig. 1.—Left: View direct into cavity and at right angles to axial wall. Center: Vertical section through center of tooth mesiodistally, illustrating retentive form at incisal angle and gingival wall (not to be confused with outline form). Right: Cross-section through middle third of tooth and cavity labiolingually.

Following is an accurate record of 12,000 gold foil operations of the past six to ten years. Some of these reports covered six and some ten years: Class 1, 17.25 per cent; Class 2, 9.17 per cent; Class 3, 37.3 per cent; Class 4, 4.17 per cent; Class 5, 32.03 per cent. It is evident that 37.3 per cent, or the largest number of fillings, were placed in Class 3 cavities, and 4.17 per cent in Class 4, a total of 41.47 per cent in cavities in the proximal surfaces of the anterior teeth.

The inaccuracy of these data lies in the fact that many cavities not here recorded were probably filled with some material other than gold foil, this unbalancing the record. It does serve to show the comparative number of gold fillings placed in the anterior teeth by a group of men who give particular attention to operative dentistry and whose practices would afford a cross-section of the type of work that comes to most practitioners of this day. It should serve to emphasize that not all have lost sight of the excellent and unexcelled qualities of gold foil as a filling material and that the public is not so adverse as it may seem to be to the presence of gold foil in the proximal surfaces of the anterior teeth.

Fig. 2.—Portion of gold inserted in linguogingivo-axial angle at beginning of operation.

In giving the indications for the use of gold foil in the anterior teeth, I can do no better than quote from a paper written about nine years ago on this sub-

ject as applied to all the teeth. The indications as thus given I have no reason to change. They now represent the observation and experience of more than twenty-five years devoted mainly to the practice of operative dentistry and give evidence that there is a large field for the placement of foil in the anterior teeth.

It is not advisable to make this class of operation for children or early adolescents where the time consumed would make the operation so fatiguing as to cause a future experience to be looked upon with dread by both the patient and the operator. The teeth of these patients, or rather the peridental membrane and alveoli, do not offer the resistance to the hand pressure and mallet blows necessary to insure a well condensed mass of gold. The same may

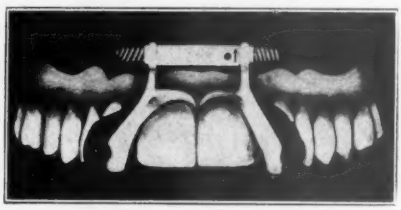

Fig. 3.—Separator adjustment. The instrument is held rigidly in place with modeling compound under the bows. Thus, the force of the mallet blows is distributed over four or more teeth.

apply to those who have undergone a long period of treatment by the orthodontist and whose teeth have not as yet become firmly fixed in the alveolar process as they will in adult life.

Patients suffering from pyorrhea alveolaris or those who from any cause may have lost considerable of the alveolar process and supporting tissues are not to be classed with those for whom gold foil is indicated. Devitalized teeth will be retained longer if not subjected to a prolonged period of malleting. Then there is that class of nervous individuals who for some unknown reason are unable to tolerate the continuous blow of the mallet. These are few in number. Gold foil is contraindicated for them.

The extent of decay or the amount of tooth to be restored is one of the most important factors in determining the kind of filling material to be used in the operation. The greater the amount of tooth structure to be restored, the less is gold foil indicated; the less the amount of decay, the greater the indication for gold foil. This we may take as an axiom.

Our judgment as to what filling material to use in the human tooth should

Fig. 4.—Gold filling (incisal angle), anchored to main body of gold already placed. The filling should now be safe from dislodgment.

be and is better than that of the patient; but there is no denying the fact that many people will not tolerate the use of gold foil in the anterior teeth. In some cases, I am unable to understand this aversion to a material of such proven quality. In others, the modern conception of esthetics as applied to the teeth makes it necessary to use a material more compatible in color with the tooth, though it cannot

compare in permanency or in any of the other requirements of a filling material, except for color. In the majority of cases so treated in which the filling has been in service for any considerable length of time, an inharmony of color has developed, leading an observer to wonder just what is wrong with these teeth: Are they decayed? Are they stained and unclean? Or do they just require the services of a dentist? Perhaps the last is the correct surmise. The patient does require the services of a dentist, with all the attainments, with all the skill, and with all the professional responsibility that the name implies, for he is on the high road to the loss of his teeth if he insists on the use of such substitutes for the best or is led to believe that he is receiving the best, when, in reality, to borrow a medical term, a nostrum is recommended that will soon show itself to have been an unwise choice.

The indiscriminate use of silicate cements has been a contributing cause of loss of more of the anterior teeth than any other single condition existent since the advent of its use. To our embarrassment, the need for the innumerable prosthetic pieces both fixed and removable that are now worn to restore teeth in the anterior part of the mouth had its origin in the unwise application of the silicate cements, creating to a greater or lesser degree the very condition that we wished to obviate; namely, inharmony in appearance of the dental organs.

I do not censure the dental profession for all of the abuses of silicate cement.

Fig. 5.—Appearance of filling at making of turn. Great care should be exercised at this point.

Fig. 6.—Gold completely placed.

The public demanded its use, once it was cunningly brought to their attention. Comparative ease of manipulation and economic necessity under many circumstances demanded its use. Moreover, the silicates are valuable to us in practice and have certain distinct indications (which are not within the scope of this paper); but surely we should make some effort to limit them to these indications and not be led on and encouraged by the few cases of successful application that all of us have observed.

Despite the fact that the use of gold foil in the anterior teeth has fallen into disfavor, there are many who have no objection to it. These patients, who are usually in middle and late adult life, desire the best material that we have to save the teeth. For these very practical people, gold foil is indicated. I do not wish to convey the idea that this is the only class of patients for whom gold foil is indicated, but rather to emphasize the indication. In fact, gold foil may and should be used in the proximal surfaces of all the anterior teeth, upper and lower, where the size and shape of the filling and the color do not make it so conspicuous as to offend the esthetic sensibilities of the patient; the operator bearing in mind the contraindications before given.

Fig. 7.—Finished operation. It is difficult to reproduce a correct labiogingival angle. (Compare Fig. 1.)

With the unsatisfactory experience that so many of our patients have had with other types of operations, it is gratifying to note the rapidly increasing numbers that come under this classification. Whatever may be the cause, it is evident that there is an increasing demand from the public for this type of operation; and to substantiate this fact, I need only to call attention to the increasing interest of the dental profession, and the demand for instruction in advanced technic by serious-minded men who wish to be prepared to render the best service.

I could go on indefinitely enumerating my many reasons for believing that gold foil is coming back into its own, to occupy the high position and rank it held in earlier dental practice before the advent of methods that have been abused and never were intended to displace the use of gold foil, but to be aids in the preservation of the human teeth. The demand of the colleges for instructors to render service limited to this type of work, the large number of study clubs organized for, and functioning exclusively in, the use of gold foil technic, all attest to these facts.

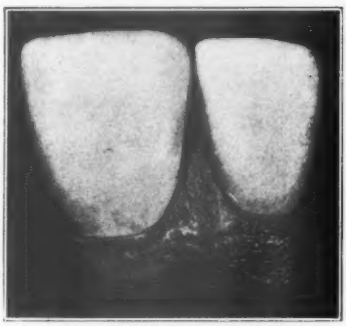

Fig. 8.—Variation from type. A very small amount of gold is visible.

TREATMENT OF PROXIMAL CAVITIES IN THE ANTERIOR TEETH WITH GOLD FOIL

To treat these proximal cavities in the anterior teeth properly with gold foil, is it absolutely necessary to have at our command instruments, devices and operating aids that have come down to us from a time when dentistry as a profession was in its infancy?

The day the rubber dam was introduced to the profession marked a new

era in the study of decay in the human teeth and made possible a method of operation that, in the light of long experience, has proved to be so nearly perfect that the surface on which we operate is insured against the progress or recurrence of the disease for the lifetime of the patient. I shall not attempt to enumerate the various reasons for the use of the rubber dam. This has been ably done by Dr. Prime in recent lectures that are published and available, about forty reasons in all being given. I can only add that a cavity preparation for any operation is more easily and best made when the rubber dam is employed.

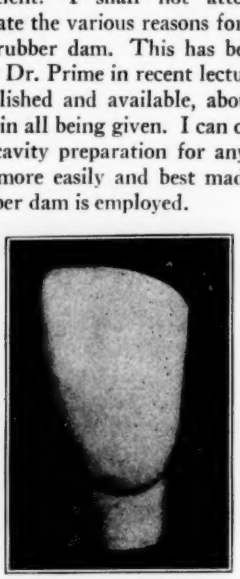

Fig. 9.—Class 3 cavity in distal surface of upper lateral incisor; illustrating variation from typical preparation shown in Figure 1. This preparation is frequently indicated.

The cutting instruments of two decades past were better suited to our purpose than those in general use today. The principal cause for the decadence in instrument design, as I see it, is the lack of standardization in measurements and of careful consideration of instruments so shaped that all the desirable qualities possible would be assured for shaping cavities for the reception of fillings and eliminating undesirable features. With this in mind, I have recently assembled a set of instruments suitable to my own needs, selecting them from existing forms and redesigning them in sizes, shapes and angles more applicable to modern cavity preparation. The elimination from the instruments of all the spring possible to be consistent with strength was intended, and this is mainly accomplished in the shaping of the shank, the angle and the upper part of the blade. All of the hatchets and hoes are made small enough from the shank down to the cutting edge to enter the smallest cavity that we are called on to make with them and yet so shaped as to eliminate as much spring as possible without taking from the strength

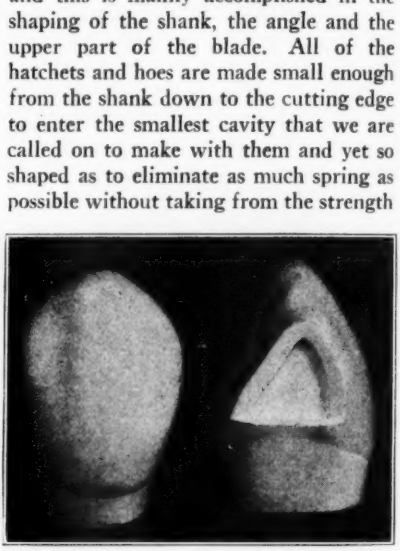

Fig. 10.—Class 3 cavity preparation in distal surface of upper cuspid to be used in all cases wherein incisal angle may be cut so as to receive bayonet plugger at proper angulation to deliver force (used in large majority of cases). Here, the variation becomes the type.

necessary to resist breakage from the force commonly exerted by good operators.

I found in designing these instruments that the thickness of the blades at their cutting edge was the most important measurement as it is with this part of the instrument that most of the work is done. I therefore standardized this dimension, making it 0.012 inch for all the instruments of the set except the spoons and the

3-2-28 hatchet. Thus, it is possible for the instrument maker to have a standard measurement by which to shape the blade in addition to the formula of Dr. Black or such variations of these formulas as I have seen fit to make for my own use.

The blades of practically the entire set of forty-two are slightly beveled from the face to the back so as to present sharp angles on each side, this giving three usable cutting edges to each instrument so that they all may be used as hoes in addition to meeting the special requirement for which each was made. When pairs are used, the handles have a small flat indentation on the side directed toward the cutting edge and the contra-

Fig. 11.—Lingual view of Class 4 operation.

bevels are marked with small grooves cut around the shank. With these distinct markings, in addition to a serial number placed on the handles, no confusion is experienced in selecting the instruments required at the moment, if they are filed in the cabinet in numerical order. The selection merely suits my individual requirements. The principles of design may be incorporated in any instrument used for cutting tooth structure.

While it is not necessary that all teeth in the anterior region be separated by mechanical means in order to gain access for operation, it is advantageous in a very large majority of cases; and rather than lose the time that any change in a standardized technic may cause, I prefer to employ mechanical separation in nearly all the cases when there is a normal or nearly normal relation. The set of six separators, as originally designed by Dr. Perry, have thus far been best suited to the purpose; but for the past fifteen years, these have not been available.

To fill an urgent need, I have spent considerable time during the past two years in redesigning these separators and making them available to the profession. I have used them extensively in my practice for eighteen months and am satisfied

Fig. 12.—Class 1 cavity filled with gold foil in which minimum of extension is required.

that an improvement has been made. They are more widely applicable than in the original design and give far more working space and freedom from interference.

With the rubber dam adjusted, the field of operation is inviting. The septal gum tissue between the teeth is retracted by the continuous pull of the elastic rubber, which excludes all moisture. By the inclusion of the six anterior teeth, freedom from interference by the rubber is assured, and a typical cavity is prepared

in the distal surface of an upper central incisor. If the decayed area is small, a small round bur is used for opening it up and making room for the hoe 6½-2½-9. This instrument is used to break down the enamel and partly form the labial and gingival wall. A small inverted cone bur is now introduced and a cut is made from the center labially and then lingually to outline and roughly form the gingival wall and definitely establish the linguogingivocavosurface angle to the form of a slight shoulder. Usually, this is the only need that we have for a bur in this preparation. The 6½-2½-9 hole is now used both as a chisel and as a hoe to establish the remainder of the outline form.

Fig. 13.—Typical Class 5 preparation. There are many variations from type, but distinctly sharp interior angles are always indicated.

With the same instrument, the resistance, retention and convenience form is made. Also, removal of the carious dentin and finishing of the enamel wall is carried out. In fact, the entire cavity preparation may be made with this useful instrument, which has been designed to lie in the cavity in such positions as are necessary to cut and shape the walls and the angles. It is probably more convenient to use other instruments specially designed for various parts of the cavity, unless one is very familiar with the use of the hoe. The small angle formers may be used to make the point angles. The 3-2-28 hatchet may be used to form the incisal angle, and the 3-2-23 hoe to form the labio-axiogingival point angle and the axiogingival line angle. Convenience points may be made with a very small spear pointed drill. The outline form may be completed and the enamel wall finished with a small contrabevel Wedelstaedt chisel. A very small hoe-shaped instrument which I recently designed to smooth the enamel walls and the axial wall and to sharpen the line angles has met with considerable approval among those who desire a highly

Fig. 14.—Placing first cylinder of noncohesive foil along mesial wall. One instrument holds the cylinder in place while the other flattens it against the wall and into the angles.

finished cavity preparation. Its virtue lies in its size and it must be used in a delicate manner. The formula is 8-1-23. To give a detailed technic of the instrumentation in this cavity preparation is not within the scope of this paper; but, in actual practice, a technic has been developed each step of which follows the preceding one in a logical sequence that is seldom varied.

Let us examine the completed cavity in some detail, emphasizing the salient points that make it approach the ideal for the purpose for which it was intended. The labial outline form presents a straight line extending to the labiogingival angle where it curves under the free gingiva, if this is in normal relation. On the incisal third, it presents a curve that blends in with this line symmetrically. This outline, when completed, closely approaches the mesiolabial angle of the tooth, this depending on the size and shape of the tooth and its position in the arch. Here, it will reflect the light and not appear as a dark stain if it is held in too closely to the center of the tooth. Here, it parallels and is in conformity with the lobe of the tooth, which is the only distinctive marking adjacent. It is in pleasing harmony with the size and shape of the tooth and is not nearly so conspicuous as one might think before the completion of the operation.

Fig. 15.—Manner in which cylinder that is to cover gingival wall is introduced into cavity. It is held against the axial wall by one instrument and forced against the gingival wall with the other.

The lingual outline form closely follows the labial outline and meets the gingival in a square and sharp angle, forming what I term, for the sake of euphonic description, the "gingival shoulder." Owing to the many failures in Class 3 operations, I have long felt that a more convenient linguogingivocavosurface angle should be adopted than the one that is held in closer to the center of the tooth. Into this angle, we may mallet the foil most conveniently; if not to our satisfaction from the labial approach, then from the lingual, where we have a direct drive that insures close adaptation of the foil. I could compromise on any other feature of this cavity preparation should I be convinced that such compromise was an advantage to the patient, but not on the "gingival shoulder," which is indispensable to my technic. It is not new, in a comparative sense.

The gingival outline form is cut straight across at about right angles to the long axis of the tooth, not curved with its convexity toward the incisal as formerly. As this convexity is not so easy to form as a straight line and offers no especial advantages, in the interest of simplicity and an ever-increasing tendency in the past few years to a smaller and more conservative cavity preparation, the curved gingival line has been abandoned in most cases. It calls for a longer labial and lingual wall, obstructs the view of the lingual third of the cavity and presents an obstacle around which to mallet. The gingival cavosurface angle meets the labial in a definite manner, but the severity of the sharp angle is relieved by a slight rounding made in the enamel when these walls are made true in the finish of the cavity preparation.

Much of the resistance form and nearly all the retention form are made

between the gingival wall or base of the cavity and the incisal angle. This wall and angle meet the axial wall at a right or slightly acute angle and give all the stability and resistance to stress necessary. The labial and lingual walls meet the axial walls at an obtuse angle and offer little resistance and less retention. These walls remain much stronger when shaped this way.

This cavity preparation presents no unusual difficulties to the experienced operator. The foil is easily and quickly placed if a careful technic is observed. A $\frac{1}{64}$ pellet of a No. 4 cohesive gold, prepared after the manner of most gold-

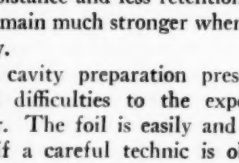

Fig. 16.—Noncohesive gold anchored by few pieces of cohesive gold.

foil operators, is placed in the linguo-gingivo-axial angle and driven to place with a small round plugger 0.4 mm. in diameter with a mallet in the hands of an assistant. Successive pieces are placed until the angle is filled up to its cavo-surface bevel. The foil is now carried along the gingivo-axial angle to the labio-gingivo-axial angle and tied in with a few small pellets. We now return to the lingual portion of the cavity and build the gold along the axiolingual angle almost down to the incisal angle, using care to keep the foil highest toward the lingual and gingival walls. A separator of the Perry type must be applied to gain better access and insure a proper contact point. The gold is now carefully worked along the axial wall and into the incisal angle; which completes most of the anchorage that the filling is to have.

We have now reached a critical point in the operation. That portion of the incisal fourth that remains to be built to proper contact and contour will rest upon the enamel and requires delicate manipulation, yet firm enough to well condense the gold. I have termed this procedure "making the turn," for that is indeed what we are doing, making a turn of a half circle in instrumentation to get a proper line of force. Some hand pres-

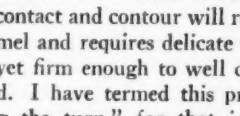

Fig. 17.—Filling completed with cohesive gold covering entire surface.

sure may be used in this incisal region, but it usually can be supplemented with mallet force on a small bayonet-shaped plugger. Indirect wedging is permissible and desirable in some locations; but usually force applied at nearly right angles to the wall is best in this situation. As there is but a small bit of gold to be placed, such force is allowable, although, generally speaking, a line of force inclined toward the long axis of the tooth is the best one to use throughout the operation. Some license away from the orthodox must be granted in difficult and unusual situations. With a

small bayonet plugger, the "turn is made" and the remainder of the operation presents no exceptional difficulties. With an improper technic, an inoperable case often results from a cutting off of the field of operation with the foil. Sufficient separation, care in the placement of the foil and proper instrumentation will insure good margins and a well-condensed filling at this point.

To finish this operation requires a little more separation (never enough to cause any great discomfort), in order that a thin metal abrasive strip may be passed into the interproximal space. This is followed by long linen strips of various grits until hard dense gold is reached to serve as the contact point. Files and knives are now used to bring the gold down to its margins, when the final finish is made with strips. A disk is rarely used, as a strip will give a better contour, and more rapidly, when cooled by the compressed air blast.

The labial outline of the finished filling is in harmony with the distinctive markings and the size and shape of the tooth. It should not offend the esthetic sensibilities of the patient or his friends, and the surface of that tooth is rendered immune to decay under ordinary circumstances for the lifetime of the patient. Do you know of any other operation for which so much could be claimed?

I have shown a typical Class 3 operation, and, with some hesitancy, I show some variations from the type. It has been my experience in lecturing on this subject and in practical instruction to graduate dentists that, when variations from type were shown, confusion and misunderstanding were the result. The variation was given more important consideration than the type and was frequently substituted when the typical operation was indicated. On other occasions, if some modifications of the standard preparations were not shown, the impression was given that all cases were to be treated in a stereotyped way. We must have a standard and modify this standard to suit the conditions met in practice. Some of the more important variations from type are here given, largely in an illustrative way, with short references in the text to the illustrations.

There are cases in which gold foil can be used in the anterior teeth, provided we assure the patient that only a small portion of gold will be visible. While this is not the operation of choice, it is much better practice to accede to the patient's demands than to restore the tooth with other materials that do not possess such permanent qualities. We may as well admit that esthetically gold foil does not register 100 per cent, and as we have no material that meets the ideal requirements to restore lost tooth structure, we must at times compromise on cavity preparation to gain our ends. We need not sacrifice any of the principles of extension for prevention to make this compromise, and to one long experienced in gold foil operating, it is no compromise at all. It is merely a difference of opinion as to what most nearly meets the esthetic requirements.

It is my opinion that the standard preparation shown before is less objectionable in appearance as it permits the light to reflect from its surface at such angles that the true gold color is seen instead of a darkened area or line. But a difference of opinion exists in the profession itself on this question of esthetics as well as with the patients whom we serve. I have in the past demonstrated, by means of carvings in plaster, models and photographs thereof, cavities in the anterior teeth that I felt fulfilled the ideal requirements for a gold foil operation. They represented the best thought that I now have on this subject. I have

clinically demonstrated repeatedly with the aid of a large group of trained clinicians the same preparation, and in each and all instances, the diversity of opinion among the observers as to just where to terminate the labial cavosurface angle has been marked. This proves to me that in our everlasting efforts to conceal our art, we meet with a world of confusion and we must recognize the fact that we are treating people as well as teeth, each case presenting a problem unto itself and demanding to be treated accordingly.

Now let me state that this phase of the paper was not written for the student nor for those of limited experience in gold foil work, as I have no desire to add to confusion. For them, the standard preparation should be adhered to. It requires long practice and much experience to vary from the typical successfully. To omit the variations from type would not give a complete presentation of the subject.

The cavity the labial outline form of which is illustrated is not too difficult to fill properly. The access is somewhat limited, and at times it may be necessary to adjust a separator to gain space, from the start of the operation. A separator properly adjusted need cause no discomfort to the patient. It should be tightened slowly, the operator bearing in mind that the spring of the instrument will gain space as the operation proceeds, and that no attempt should be made to accomplish this immediately. The procedure of placing the gold and finishing is identical with that given above.

The distal surfaces of upper lateral incisors call for a modified and a simple preparation when the disto-incisal angle is well-rounded. The contact with the opposing tooth is nearly on the curved surface that makes up the angle. These are simplified and are improved esthetically by the cutting away of the angle. A direct drive with the plugger can be obtained throughout the operation, and thus "making the turn," described in the typical preparation, can be avoided. A typical outline form established here would give the impression of two opposing curves, one the incisal outline form of the cavity and the other the curve of the angle of the tooth. This is out of harmony with all the distinctive markings of the tooth and does not meet the esthetic requirements.

To a very limited degree, this may apply to the distal surfaces of certain central incisors and to the mesial of some cuspids, and here for an additional reason. The shape of the cuspid makes it very inconvenient to reach through from the labial or lingual approach to the opposite side of the tooth, and we experience difficulty in condensing the middle third of the filling. Where permissible, an incisal approach is desirable. For these reasons and others, the distal surfaces of the upper cuspids require a similar preparation, and, for this tooth, the variation becomes the type. The filling of this cavity, once considered the most difficult to fill in the human mouth, with proper cavity preparation becomes just an ordinary procedure. This type of cavity can be used only where the incisal angle or wall may be established in such position that the marginal ridge of the first bicuspid does not preclude a proper line of force with which to condense the gold. Finished, these fillings are often smaller than typical ones in central incisors. The angle at which the gold is finished incisally literally sheds any force that would tend to dislodge it.

Under certain conditions, it will be found necessary to extend the linguogingival angle farther lingually to give better access to the cavity in placing the gold. It is impossible to change the outline form of a cavity at any given point

without making compensating changes in the remainder of the wall; therefore, a curve is introduced at the incisal third of the lingual wall, meeting a tangent of the gingival two-thirds. This change in outline gives an easier incisal approach and a very accessible linguogingivocavosurface angle.

I find these preparations indicated in by far the majority of cases. There are conditions that prevent foil from being well placed in the incisal angle in this preparation and a special one must be used. I then prefer to use the one here shown that was designed by James Mark Prime, of Omaha.

The distal surface of lower cuspids is most conveniently filled from a labial approach and the preparation is similar to that described for a central incisor except for the lingual wall, which is left standing. The enamel of this wall is thick and strong and is capable of withstanding the mallet force applied. Its cavosurface angle is extended to an immune position, and an otherwise extremely difficult operation is reduced to simplicity.

Time will permit me to describe but superficially cavities in the lower anterior teeth. In the lower incisors, the lingual wall is usually left standing, as in the lower cuspid, and as much strength left for the incisal angle as possible. These surfaces are usually immune and a very conservative preparation is made.

Cases in which the incisal angle is involved offer no special difficulties in operating other than that they require considerable time in placing the gold. The older types of cavities are too conspicuous to be tolerated by the majority. The illustration given here better meets esthetic requirements. They are only to be made in selected cases as experience teaches that they will not stand biting stress over a long period of time. The gold will stretch and a leak will appear at the incisal angle.

The foregoing is a description of the technic that I have used for more than twenty years, with such slight changes as I have seen fit to make in cavity design, always toward the conservation of the tooth structure. It is practical and it is teachable. I have made every effort to standardize it and reduce it to such simple requirements that the practitioner of average ability can apply it in his everyday work.

CLASS 1 CAVITIES IN THE PITS AND FISSURES OF BICUSPIDS AND MOLARS

Class 1 cavities in the pits and fissures of bicuspids and molars usually make their appearance in young people, and gold foil operations are limited to those teeth that will bear the mallet force necessary to good condensation without injury. The youth and temperament of the patient must be taken into consideration. I find that young patients, as young as 9 years, are better controlled if a rubber dam is adjusted and the operation completed in the same manner as for an adult. It is surprising how amenable children are to the use of rubber dam, instruments and mallet force. An otherwise intractable child usually becomes an ideal patient as soon as the rubber is applied, and remains so unless the work is prolonged to a degree not in keeping with his age.

For these young people, gold foil fillings in the pits and fissures of teeth create a pride of possession too often absent in the adult. In them, the vain, unreasonable antipathy frequently found in adults to the color of gold does not exist and the finish and neatness of the operation is appealing. To them, it is an experience and an education that they will probably carry through life, and it will be difficult indeed in future years to in-

duce them to tolerate anything inferior to these childhood operations.

The excellent qualities of gold foil apply to these cavities as well as to any other, and there is a large field for its use. I realize that economic necessity, temperament, expediency and many other excuses may be found for not using gold foil in the pits and fissures of posterior teeth, but I am not looking for these excuses, but rather for the indications for use of gold foil and I find them to be many.

The technic for Class 1 cavities is probably more easily mastered than for any other cavities, but their filling requires extreme care. They are usually small and frequently inaccessible. Great care must be used to protect the margins and a proper line of force in placing the gold is imperative.

The fissures are extended to the point of immunity, but this does not always mean to the marginal ridges. These surfaces are always immune, and it is the faults in the enamel that we are correcting. When that has been accomplished, the cavity need be extended no further. It is the intention to remove the least possible amount of tooth structure to accomplish our purpose and small burs and instruments are necessary. As cleavage of the enamel rods with hatchets and hoes will enlarge the cavity more than we anticipate, it is good practice to cut most of the cavity with small fissure burs and plane and slightly bevel the walls with chisels and hoes used parallel to the occlusal surface of the tooth.

To fill these cavities requires care as they are usually so small that a false step of the plugger will chip the margins. It is my practice to use cohesive gold throughout unless the cavity assumes larger proportions. Then the walls are lined with noncohesive cylinders pressed very thin and the operation is completed with cohesive gold.

If the cavity is small, and they frequently demand mere threads of gold, a burnished finish is best. In somewhat larger cavities, the gold is brought to its margins with burs and stones and finally finished with some abrasive and polishing material.

In filling pit cavities, the outline form may be round or oval, and if the cavities are small, a plugger may be used that is slightly less in diameter than the cavity. A point of the Royce type that has a tendency to force the gold to the axial walls gives the best results, as the space is too small for much stepping of the instrument.

In connection with pit cavities, it is well to mention the fillings made to prevent wear on the abraded points of cusps that have been given so much attention by Dr. Prince. His technic, as I understand and use it, consists of sinking a round bur half its depth into the abraded area, and following with a very small bur that cuts a slight retention pulpally. When the operation is complete, a section would show a piece of gold resembling a tack, its head toward the occlusal aspect. Platinumized gold foil will make a hard dense surface that is highly resistant to wear and yet not so hard as to cause trauma. I know of no other operation in dentistry whereby so much can be gained with so little effort.

CLASS 5 CAVITIES

A paper written on the treatment of cavities in the anterior teeth with gold foil would not be complete without inclusion of the cavities that occur in the gingival third of teeth, Class 5 cavities. In a paper on erosion,[1] a detailed technic

1. Ferrier, W. I.: Clinical Observations on Erosions and Their Restoration, J.A.D.A., 20: 1150 (July) 1933.

for the restoration of eroded areas with gold foil and that applies to decayed areas as well was given. I shall draw largely from the subject matter of that paper in this discussion. If a technic has merit, it does not change materially in a few years; and unless it has merit, it should not be presented; therefore, it is useless to change a presentation for the sake of a changed phraseology. My conclusions, reached on clinical observations of areas of erosion, have not changed, although they were written seven years ago.

The frequency of the occurrence of areas requiring restoration was determined from the same data given for Class 3 cavities, and although these data apply to all Class 5 cavities, they give some conception of the place gold foil restorations should assume in the average practice. The percentage of Class 5 cavities filled with gold foil in 12,000 operations was found to be 32.03. In my own practice, over a period of ten years, it was 34.4.

If I were limited in the use of gold foil to one class of cavities and deprived of its use in all others, I would choose to use it in Class 5 cavities. Indications for its use are so frequent and the results so satisfactory that I have no other choice in teeth that are not too conspicuous or patients too discriminating. Any other material comes so far from measuring up to the degree of excellence of gold foil in these cases that it is with reluctance that I employ anything else and then only for esthetic reasons.

We frequently hear the assertion that gum tissue takes more kindly to highly glazed porcelain than to any other substance known. This may be true under certain conditions, but it is not true as far as fillings are concerned, as we never have the opportunity of placing porcelain and porcelain alone under the free gum margin. It is always accompanied with cement of some kind and the resultant joint cannot in any manner compare with a beautifully finished gold foil margin, no matter how well the inlay may fit.

Now it does not follow that because men become proficient in gold foil work, they lose sight of the excellent qualities of other materials. I have found among the men who employ gold foil the most versatile operators I know and also the most discriminating. Their work in other branches of operative dentistry keeps pace with their foil work, and it is from such men that we get the most reliable opinions on the comparative qualities of filling operations. They are generally agreed that a well placed gold foil filling offers less irritation to the surrounding tissues than any other material known.

The technic is a simple one. A proper application of the rubber dam affords an excellent field of operation and an especially good opportunity to give the operation the fine finish necessary at the gingival margin, which usually lies in cementum. Without its use, a filling of any kind in this position cannot be properly finished.

I have but recently designed a cervical clamp that gives to me a better field of operation than any I have used thus far. The labial jaw lies well below the plane of the gingival wall of the cavity and an operation may be carried out with but little interference.

The cavity preparation is extended well out to the mesial and distal angles of the tooth, somewhat beyond the eroded or decayed area toward the incisal edge or occlusal surface and slightly beneath the gum. This includes all of the wasted area. The outline form is obtained by the use of a small inverted cone bur held

endwise to the wall on which we are working. All the walls, except the occlusal, are shaped in this manner, and it is formed by the bur held at right angles to the axial wall, which is roughly formed in the same manner, the cavity being finished with a 6½-2½-9 hoe, a very simple operation.

The occlusal and gingival walls are parallel or slightly undercut to obtain retention; but the mesial and distal walls converge toward the axial wall, as in an inlay preparation. Their angles are of assistance in the starting of the gold, but they have little to do with retention in the finished operation. They are formed in this manner to give them strength to withstand the wedging of the gold. In the outline form, the angles are sharp and definite, being so made to coincide with the outline of the eroded area with the least possible cutting. In cavities of decay, where the same preparation is used, the chalky and whitened enamel runs up along the mesial and distal angles of the tooth in fine lines, terminating in points that almost coincide with this cavity preparation. Thus, extension for prevention is obtained exactly where it is wanted, with a minimum of cutting.

In building the gold, noncohesive foil in conjunction with cohesive foil is preferred, although the entire filling may be built in cohesive gold. I shall describe the former of the two methods.

A cylinder of noncohesive No. 4 foil consisting of one-eighth sheet is placed along the mesial wall, the end of the cylinder resting against the axial wall and wedged firmly to place with as little manipulation as possible. Care must be exercised in holding the cylinder with one instrument while wedging.

In like manner, the distal wall is covered with a noncohesive cylinder. The gingival wall is covered by introducing a one-eighth cylinder transversely across the cavity, one end resting on the gingival wall and the other touching the occlusal wall. The occlusal half of the cylinder is now forced against the gingival wall and well into the axiogingival angle, securely locking the gold already placed. The occlusal wall is treated in the same manner and the peripheral walls of the cavity are completely lined with noncohesive gold.

The lining of these cavity walls with noncohesive gold affords a cushion to mallet the cohesive foil against, thereby protecting the margins and making it possible to complete the operation with less regard to the line of force used. Noncohesive foil is soft and has great wedging properties. A line of force slightly inclined toward each wall is all that is necessary.

A one-thirty second pellet of annealed foil is now introduced between the cylinders and pressed lightly to place. Another is placed in similar manner, and the two are malleted against the axial wall and into all the line angles, wedging and securing the noncohesive gold already placed. Successive pieces of various sizes are placed and malleted, care being taken to wedge the noncohesive gold against the cavity walls, pinching it off as the margins are reached, so that when the filling is built up, the noncohesive foil will be entirely covered by the cohesive foil. If some of the noncohesive is not covered with the cohesive foil, it matters little. Cohesive gold gives a finer finish and is desirable, but not essential to a good operation.

In finishing the filling, the bulk of the gold is best removed with files and the gingival overlap carefully removed with a sharp Wedelstaedt knife. At this point, great care must be used to avoid ditching the cementum below the margin of the

filling. Disks must be used with caution at this point, but can be employed with more abandon on the other parts of the gold. Finally, a rubber cup charged with dry pumice is lightly rotated against the gold, and the operation is complete. The time consumed from start to finish should not be more than one hour and fifteen minutes for the average operation by a gold foil operator of average ability. An operation that has no peer in the operative field completed in one appointment and yet made use of by a comparative few.

Medical and Dental Building.

GNATHODYNAMICS

By ARTHUR O. KLAFFENBACH, D.D.S., Iowa City, Iowa

GNATHODYNAMICS treats of the physical forces used in mastication; *gnatho* being a combining form from the Greek, meaning jaw, and dynamics treating of the moving moral, as well as physical, forces of any kind, or the laws that relate to them. This definition may be accepted as indicating, in a general way, the scope of this subject.

The idea of measurement of the forces of mastication is not a new one. In fact, more or less inaccurate or crude devices for this purpose date back more than a century. A retrospective survey of the writings and experiments by Americans, Norwegians, Hungarians, Frenchmen, Germans and Italians, and their various devices, indicates the sustained and progressive evolution of this subject.

A paper read at Davenport, Iowa, in May, 1893, and entitled "Anchorage of Proximate Fillings in Bicuspids and Molars,"[1] by G. V. Black, with the discussion which followed, is very pertinent because some of the statements therein were made prior to the perfecting of Dr. Black's gnathodynamometer. It also gives some idea as to the estimate of the profession regarding the force, or poundage, the human jaw is capable of exerting.

1. Black, G. V.: Tr. Iowa D. Soc., 1893.

In this paper, Dr. Black says:

So far as I know, we have no apparatus for measuring the force of the bite and in the more scientific sense it remains an unknown factor.

Hans Block, of Dresden, Germany, in his paper on mastication in the *Dental Cosmos*, 1893, page 187, states that some acrobats can close the mouth with a force of 500 pounds, and that an ordinary person can exert a force of 300 pounds. But these statements do not seem based upon accurate determinations. The force capable of being exerted is much greater upon the posterior teeth than upon the anterior. This is on account of their different relation to the muscles closing the mouth.

In the discussion which followed the presentation of this paper, J. R. Patrick said:

I first commenced my experiments with different kinds of nuts, the ordinary hickory nut, the three-cornered Brazilian nut and the black walnut. I amused myself feeding hogs with them from time to time, and I noticed that a hog in attempting to use these nuts could crack them in every direction; in other words, the hog turned them up and finally crushed them.

That was the initial point of my education. There was no satisfaction in that. While on my visit to Bethlehem, I obtained quite a number of nuts of different sizes such as I have mentioned. I put them under

a machine to try their resistance, and there were crushing machines there which registered anything from a grain up. The result was that a Brazilian nut at the equator—that is between the poles—required 85 pounds to crush it; at its weakest point at the pole, 98 pounds. The common hickory nut at the equator at one side—that is on the side on which there is no stem, 70 pounds; at the stem 88 pounds; at the poles 140 pounds. Black walnuts at the equator, 110 pounds; at the stem, 95 pounds; at the poles, 600 pounds. We then selected some of the strongest men we could find (laborers) and we had them cracking hickory nuts at different places, and only one man cracked a hickory nut at the equator away from the stem. None of them could crack a walnut. So I approximately set down a powerful human jaw at 95 pounds. I have heard the enormous strength of the human jaw stated at from 500 to 800 pounds. I will say in advance I am now making a machine to test the strength of the human jaw, and I have met with a good many difficulties in connection with it. I think I will be able to complete one by the time we meet in Chicago, by which I can measure the strength of the human jaw of 2,000 persons, and I guarantee that none of them will exert a pressure of over 100 pounds.

Dr. Noyes expressed his opinion as follows:

It has been suggested to me that probably the crushing force exerted by the jaw may possibly be several fold greater when the molar teeth are approximated within one-sixteenth or one-eighth of an inch than when we have a hickory nut between them, because the power of the levers and of the muscles acting upon them is enormously greater than in the widely opened position. The muscles act in an unaccustomed manner also, when the mouth is opened widely.

In closing the discussion, Dr. Black said:

I was glad to hear Dr. Patrick speak of the means used by him for making measurements. The crushing strength of the jaw is considerable, and the means used are undoubtedly insufficient. We must get the teeth as closely together as possible in the weighing of crushing strain. The jaw with the mouth wide open, as with a large walnut, cannot exert its normal force—at least I would judge as from my own efforts and from the efforts I have seen.

Speaking of the hog, I have seen the hog pass a walnut forward in his mouth in order to crush it. The mouth was spread open so wide that he could not get the force of his muscles. I hope Dr. Patrick will weigh the force of the human jaw by the machine he speaks of. I shall certainly be dissatisfied unless the teeth are brought as closely together as circumstances will allow. It is possible to contrive an instrument to bring them close together. If I had been well this spring, Dr. Sawyer and I would have been able to exhibit such an instrument here to determine what this force is. But it will be done soon, and I shall be glad to see what there is of it.

Shortly after the presentation of this paper, Dr. Patrick developed an instrument for measuring the force of the bite, which was presented at the Chicago Congress and is illustrated in the Illinois Dental Society proceedings. At that time, George Dennis also exhibited a measuring device that he had constructed and read a paper entitled "A Study of the Masticating Force of the Human Jaws." As neither of these instruments apparently was very accurate or satisfactory, they were soon discarded.

Dr. Black picked up the germ of the idea of measuring the stress which is exerted in the occlusion of the teeth and shortly after the reading of his paper also created a gnathodynamometer, as recorded in his "Physical Characters of the Human Teeth."[2] His work in this field has stimulated others and, as a result, gnathodynamometers were devised by

2. Black, G. V.: D. Cosmos, 37:353 (May), 469 (June), 553 (July), 637 (Aug.), 737 (Sept.) 1895.

Harper, Noyes, Bronner, Henze, Köhler, Licktiag, Haber and others, who have made significant contributions to this field of endeavor.

A survey of the gnathodynamometers at hand reveals the fact that none of them are entirely satisfactory, and that all of them are more or less inaccurate. That Dr. Black was cognizant of this fact is disclosed by the following:

> No matter how accurate these instruments are graduated, there is a considerable range of error in their use. This is partly for the reason that persons will bite near the extremity of the biting-pads, or distant from the extremity, making a difference of several pounds in the hundred. Again, it is not practicable for persons to so fix the instrument between their teeth that the stress will be exerted in a perpendicular line, which is another cause of error. Altogether the range of error is not much less than ten per cent. Therefore it is only claimed that the figures given are approximately correct. They are more often too low than too high.
>
> Another serious difficulty in taking records with the gnathodynamometer is in getting patients to exert the full stress of which they are capable. The instrument is not pleasant to bite upon, and many persons are fearful lest they break their teeth.
>
> Another difficulty is that in biting on the instrument with the bicuspids and molars the buccal cusps only are used, so that the stress is not evenly balanced on the peridental membranes.
>
> With these exceptions, the instrument is as accurate as an ordinary spring scale.

In our experimental work, we found that fear of breaking the teeth in record taking could be somewhat overcome by placing small strips of unvulcanized rubber on the vulcanized rubber bite-pads covering the metal jaws of the instrument.

An accurate calibration of the gnathodynamometer used by us, which was a replica of the one used by Dr. Black, revealed that the readings of the instrument and the actual force applied was accurate up to and including 80 pounds, after which there existed an increasing discrepancy. When the reading on the instrument was 260 pounds, the actual force applied was 205 pounds, an error of more than 21 per cent.

Since the force exerted has a direct bearing on the interrelationship of the opposing teeth, the measurements obtained will vary according to the extent the mouth remains open at the time the test is made. Black's gnathodynamometer is so constructed that a space of 22 mm. (about three-fourths inch) between the opposing teeth is required at the time of insertion, and, when fully closed, keeps the opposing teeth from making contact by 14 mm. (about one-half inch). Consequently, the maximum force cannot be exerted, because of the tactile sense of the peridental membrane; a reading which does not indicate the force that the muscles of mastication are capable of exerting resulting.

Some of the factors which enter into

TABLE 1.—RESULTS OF CALIBRATION*

Reading on Instrument	Actual Force Applied	Reading on Instrument	Actual Force Applied
Pounds	Pounds	Pounds	Pounds
10	10	100	89
20	20	120	102
30	30	140	118
40	40	160	132
50	50	180	147
60	60	200	160
70	70	220	172
80	80	240	183
		260	205
		275	215

*Measurements taken near the outside or inside of the vulcanized rubber bite-pads gave a force of 12 per cent more or less, respectively, than those given.

the problem as possible variables having an influence on the measurements obtained are: (1) the kind of gnathodynamometer used and the technic employed; (2) sensitivity and condition of the peridental membrane; (3) individual's habits of mastication; (4) fulcrum (anterior or posterior); (5) osseous structure; (6) close approximation of opposing teeth; (7) pathologic conditions, and (8) cooperation of patient. These eight factors, to a great extent, account for the discrepancies in the measurements of the force of the bite as recorded in the literature available on this subject.

NATURAL DENTURES

Having realized that we are confronted by variable difficulties, that we face a problem, we enter on the next stage of the procedure and begin the accumulation of data. For the purpose of comparison and study, test bites were taken of 1,000 students and the name, age and gnathodynamometer readings of right and left molars, right and left bicuspids and central incisors in the median line, together with pertinent remarks, were recorded. These tests were conducted in a manner, and under similar conditions to those made by Dr. Black.[3]

The results are shown in Table 2.

Dr. Head cites the case of a man capable of registering 340 pounds, while Dr. Black found students in every class at the dental school who could register 300 pounds, and some of them "appeared to very easily register from 325 to 350 pounds." He adds that the variation was from 25 pounds to 275 pounds, 275 pounds being the full register of the instrument used, and among the trials there were seventeen persons who made this full register.

TABLE 2.—EXPERIMENTAL DATA

Age range, 20 to 35 years		Average, 23.4 years
	Molars	
Highest, (estimated) 290 pounds		Lowest, 45 pounds
Average, right side		157.3 pounds
Average, left side		143.4 pounds
Average, both sides		150.3 pounds
	Bicuspids	
Highest, 235 pounds		Lowest, 25 pounds
Average, right side		122.3 pounds
Average, left side		117.4 pounds
Average, both sides		119.8 pounds
	Central Incisors	
Highest, 110 pounds	Lowest, 20 pounds	Average, 49.3

In our tests, we have never found a student capable of registering as much as 350 pounds. So far, there have been two who could register beyond the dial reading of 275 on the gnathodynamometer and twelve who have exerted a pressure of approximately 275 pounds according to the instrument, or about 220 pounds actual force.

It is interesting to note that Dr. Black found the average force exerted on the molar teeth to be 171 pounds, while we

3. Black, G. V.: Operative Dentistry, Chicago: Medico-Dental Publishing Co., 1908.

found it to be 150 pounds as recorded by the instrument, or 125 pounds actual force. Does this decrease of poundage in the force of the bite indicate that mastication pressure is gradually decreasing? If so, is this due to the fact that our foods now do not require the masticatory force formerly required?

cases were taken from our clinical record files. The number of these cases was limited because only those cases in which a missing first molar tooth on one side was restored with a fixed bridge, and with natural teeth on the opposite side, were chosen. This was done in order that a comparison of the restored side with the natural teeth on the opposite side might be made.

TABLE 3.—SUMMARY OF GNATHODYNAMOMETER READINGS

No. Cases		Average Pounds
	Upper Molars	
24	Upper right molar restored	55
19	Upper left molar restored	61
43	Upper right and left molar restored	58
43	Upper right and left opposite	69
23	Male Restored	66
20	Female Restored	48
23	Male Opposite	78
20	Female Opposite	58
	Lower Molars	
44	Lower right molar restored	53
47	Lower left molar restored	50
91	Lower right and left molar restored	51
91	Lower right and left molar opposite	62
45	Male Restored	68
46	Female Restored	49
45	Male Opposite	85
46	Female Opposite	59

Upper and Lower Molars

		Pounds		Pounds
Restored side	Highest	135	Lowest	10
Opposite side	Highest	152	Lowest	12
Both sides	Restored	average		54.5
Both sides	Opposite	average		65.5
Male Highest	Restored side	132	Opposite side	152
Female Highest	Restored side	112	Opposite side	128
Male Lowest	Restored side	17	Opposite side	19
Female Lowest	Restored side	10	Opposite side	12
Age Male	Highest 73	Lowest 19	Average 28 years	
Age Female	Highest 50	Lowest 19	Average 23 years	

FIXED BRIDGE RESTORATIONS

For the purpose of measuring the efficiency of fixed bridge restorations, 134

In my judgment, there are certain fundamentals in tooth restoration that

seem to be entirely overlooked, and an intelligent conception of such fundamentals as functional capacity, overload and margin of safety cannot be fully appreciated unless we learn first the actual forces required to masticate properly the various articles of diet, and how these fundamentals are affected or restricted by such restorations.

Gnathodynamometer readings were obtained of these 134 cases within a few days after the fixed bridge restoration had been made. These were then tabulated and summarized as shown in Table 3.

Five cases registered the same on both the restored and the opposite sides. Six cases registered higher on the restored than on the opposite side. One hundred twenty-three cases registered lower on the restored side than on the opposite side.

Age did not consistently influence the bite as shown by the five cases at 20 years of age: restored, 68; opposite, 75 pounds; restored, 55; opposite, 55 pounds; restored, 35; opposite, 40 pounds; restored, 53; opposite, 62 pounds; restored, 55; opposite, 130 pounds.

The general average of the restored side (54.5 pounds) and the opposite side (65.5 pounds) shows a marked decrease over the results obtained from students (150 pounds) and by Dr. Black (171 pounds). Just why this general average of these cases requiring restoration shows a marked decrease in the functional capacity is a matter to consider. Can it be that it is the direct result of the loss of a tooth or teeth? Dr. Tylman, who has kept similar clinical records of the bite on the gnathodynamometer, says[4]:

> Such marked variance between the 175 pounds which G. V. Black states is average for the normal mouth and the 52 pounds which is the average for mouths having restorations is indeed significant. Do not these figures lead one to believe that just as Nature increases her powers of endurance gradually when a load is added, so also does she decrease these powers in proportion to the disuses of teeth? The latter condition prevails when edentulous areas are permitted to exist for any length of time without proper restoration.

Dr. Tylman's measurements compared with mine are given in Table 4.

Such general comparisons as previously charted are of great value in themselves, but it is equally important to determine by comparative study the effects of short span restorations, with vital and pulpless teeth, on the functional capacity of the

Table 4.—Comparison of Tylman's and Author's Findings

	Average Poundage of First Molar Fixed Partial Denture Restorations			
	Women			
	Upper		Lower	
Tylman	Restored 53	Opposite 61	Restored 37	Opposite 41
Klaffenbach	Restored 48	Opposite 58	Restored 49	Opposite 59
	Men			
Tylman	Restored 64	Opposite 79	Restored 66	Opposite 83
Klaffenbach	Restored 66	Opposite 78	Restored 68	Opposite 85

4. Tylman, S. D.: Clinical and Roentgenographic Observations on Fixed and Semifixed Bridgework, J.A.D.A., 14:1379 (Aug.) 1927.

restored mouth. A periodic check-up revealed a small but gradual increase in the force of the bite in most vital cases up to a certain limit, when the poundage remained practically constant but below the capacity of the opposite side. Those cases having pulpless teeth for abutments did not respond so favorably. With some, the increase was very slow and not of very great extent; while, with others, there was little if any appreciable change.

We found that 123 out of 134, or 91 per cent, of the cases supplying one molar tooth registered a greater poundage on the natural teeth on the opposite side. This is accounted for by the fact that when abnormal pressure or stress is exerted on a tooth, it is transmitted directly to the peridental membrane, producing an excessive stretching and compression of this sensitive membrane. As a result, the patient is warned of excessive pressure or overload by the discomfort or pain produced in that area. This was repeatedly manifested in obtaining the pressure measurements with the gnathodynamometer, for, in every instance, the patient ceased biting because of discomfort or pain rather than because he had exerted all the muscular power possible. To say that a fixed bridge restoration of four units is capable of doing the work possible with four natural teeth, two of which become abutment teeth, is erroneous. The load the abutment teeth will tolerate is to a great extent dependent on the discomfort or pain produced when an overload beyond the margin of safety is placed on the prosthesis. Measurements taken of fixed bridges show a decrease in poundage with each additional pontic added. For example, a bridge with a first molar pontic would register 75 pounds, while a similar bridge on the opposite side of the arch with a molar and a second bicuspid pontic would register 60 pounds. This, no doubt, is Nature's way of fortifying the abutment teeth against overload. Failure due to overload is given as a very common cause of fixed bridge failures. By direct examination, observation and study of the roentgenograms of clinical cases, we found that leverage and torque rather than overload was responsible for failures due to abnormal stress beyond the margin of safety.

While not recorded on the gnathodynamometer, the actual masticating area of the teeth involved has a direct relationship to the pressure exerted on the periodontal tissues. Since the area of surface contact is equal to the square of its diameter, by increasing the diameter of the occlusal area of a bridge pontic twice, we increase its surface contact four times.

Occlusal carvings on pontics and abutments also have a direct influence on the force required to masticate food properly. In most instances, shearing rather than compressive or tensile stress is the most efficient means of mastication. Where flat or worn occlusal surfaces exist or have been developed, the resistance to the forces of mastication may be increased 50 per cent or more.

REMOVABLE PARTIAL DENTURES

In attempting to obtain measurements of removable partial dentures, many difficulties were encountered. The great variation in design, extent of application, limited number of comparable cases, breakage, etc., all added to the complexity of the problem. Finally, 100 cases were selected for the test which were more or less comparable. The results of the measurements obtained were as follows: age range, 17 to 65 years; average, 26 years: highest force exerted, 53 pounds; lowest, 15 pounds; average, 26 pounds.

These figures show a marked decrease in biting force when compared with

those tabulated under the natural denture and fixed partial denture. Even though these figures are more or less relative, considerable value and significance regarding the relative efficiency of these two types of restorations—fixed and removable partial dentures—are very apparent.

FULL UPPER AND LOWER ARTIFICIAL DENTURES

Pressure measurements obtained from 100 patients wearing full upper and lower dentures reveal a substantial reduction in poundage registrations. In this analysis, no attempt was made to consider, to any extent, mouth conditions, fit, supporting structures, tissue conditions, physical form or mental attitude of the patient. While it must be admitted that these are factors that more or less affect the efficiency, they, when measured and associated with success or failure, involve a very complex and lengthy analysis.

TABLE 5.—DATA ON POUNDAGE

Age range 26 to 83 years	Average, 34 years
Molars	
Highest, 53 pounds	Lowest, 5 pounds
	Pounds
Average, right side	22.4
Average, left side	22.2
Average, both sides	22.3
Bicuspids	
Highest, 56 pounds	Lowest, 8 pounds
	Pounds
Average, right side	24.4
Average, left side	23.9
Average, both sides	24.16
Central Incisors	
Highest, 18 pounds	Lowest, 3 pounds
Average, 9 pounds	

The data tabulated included the patient's name, age and sex, poundage registered on right and left molars, right and left bicuspids and central incisors at the median line, tissue and ridge conditions, and notations as to length of time dentures had been worn, efficiency, etc.

In Table 5, only a few of the results that pertain directly to the poundage are given.

In comparing the pressure exerted by the artificial denture, it will be noted that the greater average force is exerted in the bicuspid region by the patient wearing the denture, while, in the patient's mouth, with the natural teeth, it is greater in the molar region: artificial dentures, average: bicuspids, 24.16; molars, 22.3 pounds; natural dentures, average: bicuspids, 119.8; molars, 150 pounds.

Satisfaction as to function was expressed by some patients capable of exerting only low pressure, as well as by those who could exert a high pressure, although, in some instances, the patient had eliminated from his diet certain foods which were hard to masticate.

Comparison of the average force possible with the natural denture (150 pounds) and with the artificial denture (22.3 pounds) disclosed that the natural denture is 85 per cent more efficient in poundage pressure than is the artificial denture.

While some of the masticating efficiency is dependent on the actual force exerted, the fit and occlusion, together with shearing and triturating force, play a most important part. Dr. House found that "it requires only a moderate amount of wear to increase the resistance enormously; only 40 per cent increase of the diameter of the contact areas of the cusps doubles the resistance to the muscular effort." A comparison of the experiments by Drs. Black and Head definitely

demonstrates the importance of functional occlusion, shearing and triturating force in reducing the force or pressure required to masticate various kinds of food.

The greater efficiency of the full upper and lower artificial denture with functional or balanced occlusion as compared with those having "only occlusion" has been experimentally shown by E. G. Christiansen. He made two sets of dentures, one with and one without functional occlusion and, by means of his tritometric method, instituted a comparison between these two types of dentures. The results of seven cases are shown in Table 6.[5]

Table 6.—Chewing Efficiency of Several Patients for Whom Two Full Dentures Were Made

Case	Sieve No. 1 Per Cent	Sieve No. 2 Per Cent	Sieve No. 3 Per Cent	Sieve No. 4 Per Cent
1	* 70.096	24.808	4.519	0.577
	† 55.777	35.359	6.872	1.992
2	* 84.685	13.674	1.516	0.152
	† 75.453	20.057	3.342	1.146
3	* 88.083	9.400	1.999	0.518
	† 65.104	27.604	6.250	1.042
4	* 67.080	27.057	5.2999	0.564
	† 17.390	66.667	13.044	2.899
5	* 54.973	39.268	5.236	0.523
	† 25.079	59.561	12.540	2.820
6	* 89.172	8.280	1.910	0.638
	† 84.842	10.180	3.169	1.809
7	* 86.613	11.156	1.623	0.608
	† 43.478	48.309	6.039	2.174

*Without functional occlusion.
†With functional occlusion.

It will be noted that there is a marked difference in the trituration of the cocoanut. In one of the functional occlusion sets, nearly four and, in the other, nearly three times the amount of nut was reduced in the same time necessary to pass through a No. 4 sieve, the finest one used, with 30 meshes per centimeter.

COMPARISON

The average poundage exerted in the molar region by the natural teeth and in various types of restorations is as follows: natural teeth, molars, average, 150 pounds; fixed bridge, molars, average, 54.5 pounds; removable bridge, molars, average, 26 pounds; artificial dentures, molars, average, 22.3 pounds.

These mean averages, while more or less relative, indicate, in a general way, the efficiency of natural dentures as compared with the various types of restorations and also show the fixed bridge to be

5. Christiansen, E. G.: Vierteljarsschr. f. Zahnheilk., 39, 1923.

TABLE 7.—STATIC CENTRAL LOAD*

	Distoclusal Inlay Upper Second Bicuspid	Mesioclusodistal Inlay Upper Second Bicuspid	Mesioclusal Inlay Lower First Molar	Mesioclusodistal Inlay Lower First Molar	Gold Crown Upper First Molar	Gold Crown Lower First Molar
	Size 3.75 by 4.5 mm. 0.149 by 0.177 inch	Size 3.75 by 6.5 mm. 0.148 by 0.256 inch	Size 3.5 by 8.5 mm. 0.138 by 0.335 inch	Size 3.5 by 8.5 mm. 0.138 by 0.433 inch	Size 7.5 by 10 mm. 0.296 by 0.394 inch	Size 7.5 by 11 mm. 0.296 by 0.433 inch
	Area 0.0264 square inch	Area 0.0379 square inch	Area 0.0462 square inch	Area 0.06 square inch	Area 0.1166 square inch	Area 0.1282 square inch
Load Pounds	Pounds per Square Inch	Pounds per Square Inch	Pounds per Square Inch	Pounds per Square Inch	Pounds per Square Inch	Pounds per Square Inch
15	568	396	324	250	128	117
20	758	528	433	333	172	156
25	947	660	541	417	214	195
30	1,136	792	649	500	257	234
40	1,502	1,055	866	667	343	312
50	1,894	1,319	1,082	833	428	390
75	2,841	1,979	1,623	1,250	643	585
100	3,788	2,638	2,165	1,667	858	780
125	4,735	3,298	2,706	2,083	1,158	975
150	5,681	3,958	3,247	2,500	1,286	1,170
175	6,629	4,617	3,788	2,917	1,500	1,365
200	7,576	5,277	4,329	3,333	1,715	1,560
225	8,523	6,201	5,087	3,750	1,930	1,855
250	9,493	6,596	5,411	4,167	2,144	1,920
275	10,416	7,256	5,931	4,583	2,359	2,145

*Relation between load on certain types of restorations and intensity or unit-stress developed on occlusal plane of restoration

far more capable of transmitting and delivering compressive stress.

INTENSITY OF STRESS

Force, as we know it, is any condition that alters a body's natural state of rest or of uniform motion in a straight line. The three elements that must be known before a clear notion of the force of mastication can be had are: (1) its place of application, (2) its direction and (3) its magnitude. The study of dynamics, which, as we have seen, treats of the action of force, is divided into two classes, kinetics and statics.

Impact, or kinetic force, which may result from the process of mastication, consists of force applied suddenly or with velocity to the teeth or restoration.

Static, or steady, loads are forces that exert gradual, steady pressure or stress on the teeth or restoration in proportion to the value of the force itself.

The intensity of stress or unit-stress may be defined as stress per unit of area. It may be designated as so many pounds per square inch.

Static central loads may be produced by compressive, tensile or shearing stress. During the process of mastication, all three kinds of stress may be utilized, the compressive in crushing and grinding, the tensile for sticky foods and candy, and the shearing, by the incisor teeth and the cusps of the posterior teeth, during lateral excursions.

The dental problem involved is to find the relation between the load measured in pounds by the gnathodynamometer and the intensity delivered on the occlusal area of the filling, abutment or pontic. The area of contact is first determined by measurement in millimeters of the occlusal length and width of the filling, crown, pontic, etc. These dimensions are then converted to inches by multiplying by 0.0394, since 1 mm. equals 0.0394 inch. The area is then obtained in square inches by multiplying the length mesiodistally by the width buccolingually; or it may be more accurately obtained with the use of an areameter. With the occlusal area involved computed in square inches, we are ready to proceed.

Let S equal intensity in pounds per square inch, P, total load in pounds and A, area of contact.

If we assume that the stress is uniformly distributed over the area, the intensity is equal to the total load over the area of contact. Thus $\frac{P}{A}$ equals S.

Therefore, if 50 pounds is the total load as measured on the gnathodynamometer and 0.0379 square inch is the total area of contact on a mesioclusodistal inlay in an upper second bicuspid, the intensity is 1319 pounds per square inch. $\frac{50.0000}{0.0214}$ equals 1319 pounds per square inch.

A knowledge of the resistance of dental materials to the forces of mastication is an important factor in the selection of materials for dental restorations. With the specifications established by the Bureau of Standards and the intensity of stress of a material such as amalgam, cement and gold alloy, expressed in pounds per square inch, it is possible to estimate approximately the requirements in relation to the mastication pressure of the individual as shown in the preceding chart. When such computations are made, ample allowance should be made for impact forces, which are proportional to the result of force times the square of its velocity, instead of the intensity of stress, as in the case of a steady or static stress.

CONCLUSIONS

1. No absolutely accurate procedure or instrument has yet been devised for measurement of the forces of mastication.

2. The power exerted by the teeth as shown on the gnathodynamometer is a

measure of the power of resistance of the peridental membrane and not the entire force of the muscles of mastication.

3. The poundage that the teeth exert on any object or food is individual and consequently cannot be standardized.

4. With a better understanding of the science of gnathodynamics, it is possible to design and construct more efficient prosthesis.

5. A comparison of the fixed partial, removable partial and the full artificial dentures shows that the fixed bridge is capable of everting the greatest pressure.

6. Abnormal stress rather than overload is the destructive factor of short span restorations.

7. The load placed on the abutment of teeth increases with each pontic added and the pressure exerted on the pontic by the patient is relatively reduced because of discomfort or pain.

INCREASE IN SIZE OF THE CLINICAL CROWN OF HUMAN TEETH WITH ADVANCING AGE*

By RUDOLF KRONFELD, B.S., M.D., D.D.S., Chicago, Ill.

DURING the past decade, the concept of the relationship between gingiva and tooth surface has been changed more radically than any other fundamental concept in dental science.

Prior to 1921, this relationship was usually described thus: The gingival tissue is normally attached to the tooth at the cemento-enamel junction (gingival line), and it remains there unless there is some pathologic interference. If these premises were accepted, the following would consequently have to be true: 1. In every erupting tooth, of which only a small tip is visible, a crevice (subgingival space) would exist, extending around the entire crown and down to the cemento-enamel junction. 2. The free gingival tissue would protect the enamel, since gingival decay in young persons does not extend to the cemento-enamel junction, but leaves the cervical enamel intact. 3. The condition found in all older people, as well as old animals, in which the bottom of the gingival crevice is located on the root surface, would have to be considered abnormal, or pathologic.

The work of Gottlieb, Orbán, Skillen, Mueller, Becks, Bödecker and many others has demonstrated that this old concept of the attachment of the free gingiva at the gingival line is incorrect. Gottlieb showed that at the time a tooth begins to erupt, most of the enamel is still in organic union with the epithelial tissue left over from the original enamel organ (Fig. 1). He called this tissue, which is attached to the still unerupted part of the enamel, the epithelial attachment. Gottlieb also showed that at no time during life is the location of the gingival crevice on the tooth surface stationary. In youth, the bottom of the crevice is located on the enamel. With advancing age, it gradually moves rootwise, going beyond the cemento-enamel junction, so that a portion of the root is exposed.

*From the Research Department of the Chicago College of Dental Surgery, Dental Department of Loyola University.

*Read before the Section on Therapeutics, Pathology and Research at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

Gottlieb's study of the relationship between gingival tissues and tooth surface was made on sections through well-fixed, well-prepared human jaw tissues from persons of different ages. Such material is indispensable to a successful study of the gingival tissues. Any other material, particularly the type of animal specimens which had heretofore been used, cannot give the correct conception of the actual facts.

The epithelial attachment to the enamel and the changing location of the gingival crevice easily explain the clinical observations cited above, which could not otherwise be accounted for. When the tip of an erupting tooth appears in the oral cavity, the major portion of its enamel is still in organic union with the gingival tissues. Therefore, there is no deep crevice extending to the cemento-enamel junction. This organic union of the gingival tissues with the cervical portion of the enamel explains why this enamel does not decay in young patients: it is not yet erupted, not yet accessible

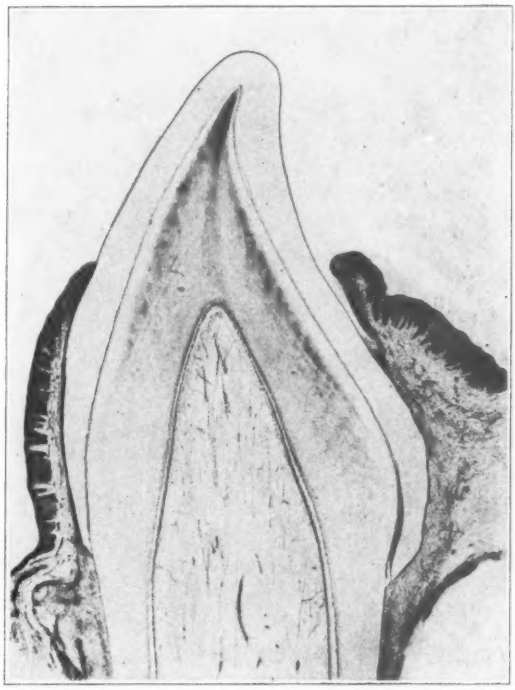

Fig. 1.—Labiolingual section through erupting deciduous lower central incisor (at age 9 months). Approximately one half of the anatomic crown is erupted. The other half is still united with the gingival tissues. The depth of the gingival crevice is zero on the labial (left) side, and 0.8 mm. on the lingual (right) side. (×15.) (In this photomicrograph, as well as in Figure 2 and Figs. 5-10, the approximate outline of the enamel, which was lost by decalcification of the specimen, has been drawn with ink.)

to oral fluids and, therefore, not accessible to caries. With age, the bottom of the crevice gradually shifts rootwise, finally passing the cemento-enamel crevice, the cervical portion of the root being thus exposed.

In a child, the following conditions are found when a tooth is erupting: Surrounding the erupted portion of the enamel is a thin pink border of gingival tissue, the free end of which is the gingival margin. Behind and below the gingival margin, between it and the enamel surface, is a shallow cleft, the gingival crevice. Rootwise from the bottom of the gingival crevice, the tissues are still united with the enamel by the epithelial attachment, which extends to the cemento-enamel junction.

In an erupting tooth of a child, the gingival crevice is very shallow. Unless it is disturbed by mechanical interference (from the toothbrush, dental instruments or food particles) or by irritation by deposits, the crevice may have no depth at all, or it may be from 0.5 to 2 mm. deep.

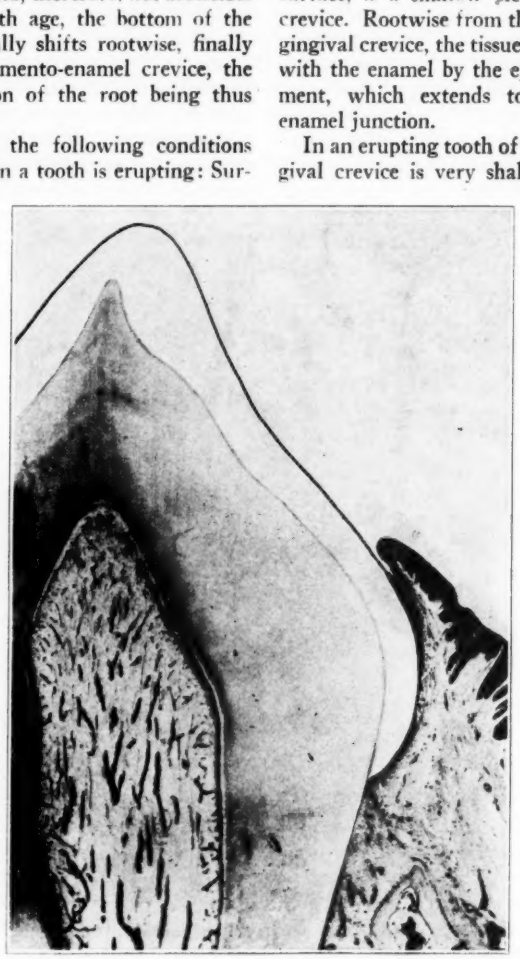

Fig. 2.—Lingual side of crown of deciduous upper cuspid (at age 2 years). The cervical one third of the enamel surface is still united with the epithelial attachment. The gingival crevice is 0.3 mm. deep. (×15.)

A typical example of this is illustrated in Fig. 1. Around this tooth, the depth of the crevice on the labial side of the crown is zero. On the lingual side, it is approximately 1 mm.

In the further process of eruption, the crown gradually rises above the surface of the jaw. At the same time, the soft tissues gradually become detached from the enamel surface, an increasing surface of enamel being exposed. When the erupting tooth has reached the occlusal plane and met its antagonist, approximately three fourths to four fifths of the total height of the enamel has erupted. The remaining cervical portion of enamel is still in organic union with the covering gingival tissues (Fig. 2).

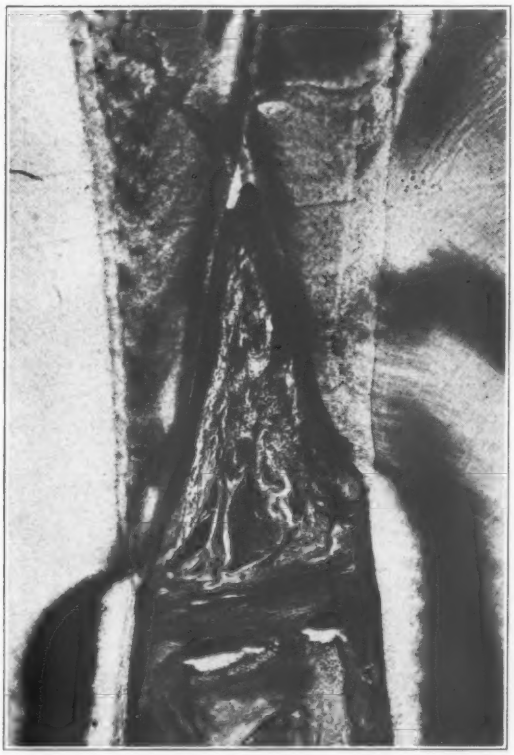

Fig. 3.—Mesiodistal ground section through interdental tissues between two human upper molars. (Section prepared by C. F. Bödecker and Edmund Applebaum and published in D. Cosmos, 76:1127 [Nov.] 1934.) The photomicrograph shows the dentin and the enamel from the cemento-enamel junction to the contact point of both teeth, the interdental bone crest, the transeptal fibers of the periodontal membrane and the interdental soft tissues. On either side of the interdental papilla, there is an epithelial attachment to the enamel, extending from the cemento-enamel junction almost to the contact point. (×25.)

The relationship between the epithelial attachment and the enamel is usually

studied in decalcified sections through teeth and investing structures. These preparations have the disadvantage that the enamel has been completely dissolved and lost; which makes it difficult for anyone not familiar with such material to visualize the conditions as they were originally. Recently, Bödecker and Applebaum[1] have succeeded in preparing ground sections through several human teeth and their supporting tissues. In these sections, both enamel and epithelial attachment are in a perfect state of preservation, and thus every possibility of doubt or error in the interpretation of the specimens is eliminated (Figs. 3 and 4).

Fig. 4.—Higher magnification of epithelial attachment to enamel of left tooth in Figure 3. The epithelial attachment consists of several layers of squamous epithelial cells, evenly and firmly adhering to the enamel without any evidence of separation. (×47.)

1. Bödecker, C. F., and Applebaum, E.: D. Cosmos, 77:1127 (Dec.) 1934.

The presence of an attachment of the epithelial tissue to the cervical portion of the enamel, as it is illustrated in Figures 1 and 2, must necessarily have certain

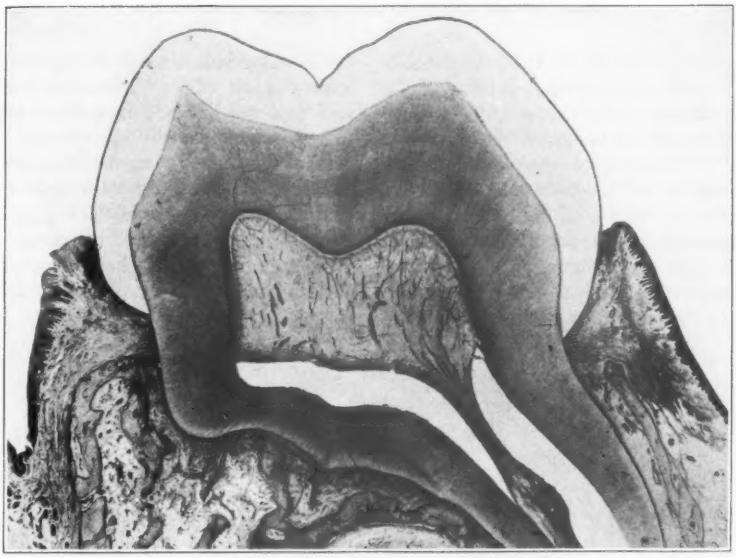

Fig. 5.—Buccolingual section through deciduous upper second molar (at age 3 years). The cervical one third of the enamel surface is still united with the epithelial attachment. The depth of the gingival crevice is zero on both the buccal and the lingual sides of the crown. (×9.)

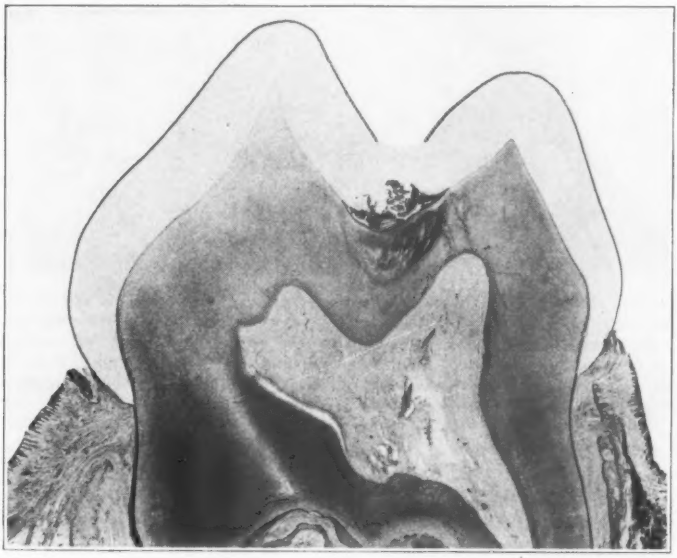

Fig. 6.—Buccolingual section through deciduous upper second molar (at age 4½ years). Only about one fifth of the total height of the anatomic crown is still united with the epithelial attachment. The depth of the gingival crevice is zero. (×9.)

clinical manifestations. It is a well-established fact that only that portion of the tooth surface which is accessible to oral fluids is subject to decay. In Figure 2, only the portion of the enamel above (crownwise to) the bottom of the crevice is bathed in saliva. If the tooth were to be attacked by gingival or approximal caries, the destruction of the enamel would extend gingivally only to the bottom of the crevice, and the yet unerupted

ity in extracted teeth of young patients with gingival caries. This also explains why calculus has not been deposited on the enamel surface of such extracted teeth next to the cemento-enamel junction.

With advancing age, the amount of enamel surface to which the gingiva is still attached becomes less and less. Therefore the white, chalky, superficial decalcification of the enamel which is so commonly observed in children with

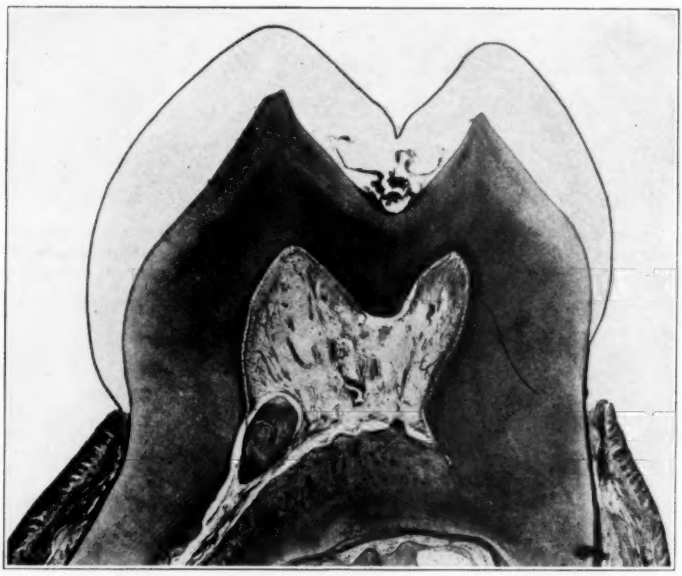

Fig. 7.—Buccolingual section through deciduous upper second molar (at age 11 years). On the lingual (left) side, the bottom of the gingival crevice is located at the cemento-enamel junction. On the buccal (right) side, it is located 1 mm. rootwise from the cemento-enamel junction. The depth of the crevice is zero. (×9.) A comparison of Figures 5, 6 and 7 shows how, with advancing age, the gingival crevice is displaced apically, without much change in the condition of the gingival tissues or in the depth of the crevices.

2 or 3 mm. of enamel toward the cemento-enamel junction would remain intact. This explains the clinical observation, well known and repeatedly illustrated by G. V. Black and many others, that there is a zone of intact enamel rootwise from the gingival border of the cav-

poorly cared-for mouths is, later on in life, found halfway between the occlusal surface and the gingival border. If gingival caries sets in early in childhood, the carious defect or corresponding filling, which at the time extended to the bottom of the gingival crevice, will be

quite distant from the gingival margin a few years later. For the same reason, the gingival border of shell crowns, Richmond crowns and jacket crowns made for children will, after several years, be found some distance from the gingival margin. An identical change also takes place in adults, but the process of detachment of the gingival tissues is much slower, and therefore it takes considerably longer before any distance between the border of a dental restoration and the gingival margin can be noticed.

The cemento-enamel junction, the old "gingival line," has no significance whatever in the process of detachment of the gingival tissues except a purely anatomic one: it marks the dividing line between enamel and cementum. Therefore, Gottlieb has suggested a special terminology: he calls the enamel covered portion of the tooth the anatomic crowns, and the cementum covered portion, the anatomic root. Clinically, that portion of the tooth which is actually erupted (exposed) is called the clinical crown, and the remain-

Fig. 8.—Lingual side of crown of erupting upper second bicuspid (at age 11 years). About one half of the anatomic crown is erupted. The depth of the crevice is zero. The hornified layer of the gingival epithelium extends to the enamel surface. The alveolar bone crest is located crownwise from the cemento-enamel junction. (×14.)

der of the tooth, which is still united with the investing tissues, the clinical root. Thus, it may be said that in youth the clinical crown is smaller than the anatomic crown, and in old age the clinical crown is greater than the anatomic.

It is impossible to give any definite data or figures for the progress of the soft tissue detachment from the tooth surface. In certain mouths, all of the anatomic crowns are exposed at the age of 40; in others, at least for some teeth, there is an epithelial attachment to the enamel at 50 years or even later. For the maintenance of dental health and function, the more slowly this gradual exposure of tooth surface takes place, the better.

The dental operator should always be aware of the fact that the level of the gingival margin, as he finds it in the patient's mouth, is only temporary. As time goes on, a gradual recession of the gingival border is inevitable, resulting in an exposure of additional tooth surface. No matter how carefully an approximal

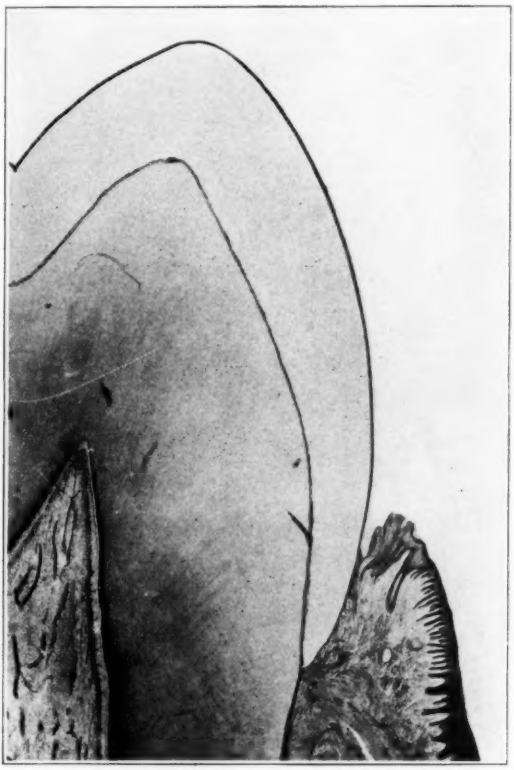

Fig. 9.—Lingual side of crown of upper second bicuspid (at age 14 years). The cervical one fifth of the anatomic crown is still united with the epithelial attachment. The gingival epithelium is intact, the depth of the crevice 0.5 mm. (×14.)

or gingival cavity is prepared, how skilfully the margin of a jacket or Richmond crown is placed behind the free gingival tissue, in ten or twenty years the margin of the filling or crown will be exposed by physiologic age changes, and will be visible above the gingival margin.

Figures 5-7 show buccolingual sections through upper second deciduous molars at the ages of 3, 4½ and 11 years, respectively. That portion of enamel which is exposed and protrudes into the oral cavity increases gradually with advancing age, until in the oldest specimen the entire anatomic crown is exposed.

A similar and perhaps still more striking change is found in the upper second bicuspids (Figs. 8-10). At 11 years, shortly after eruption, only a relatively small portion of the anatomic crown is exposed. At 14 years, the exposed area of enamel is considerably greater, the

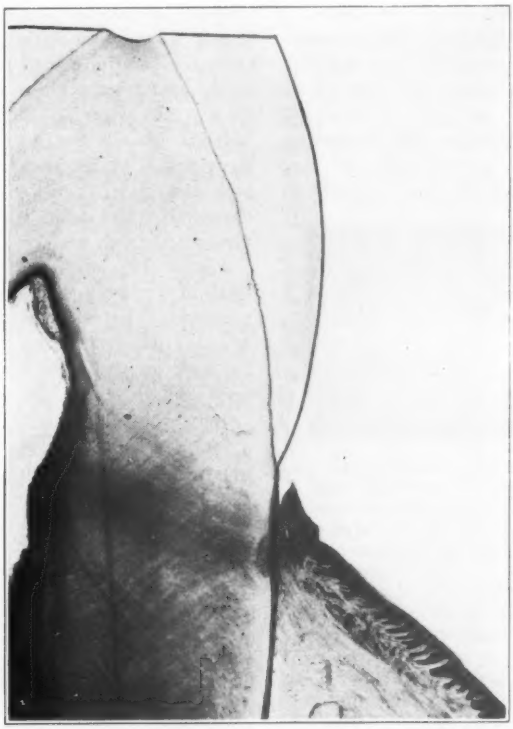

Fig. 10.—Lingual side of crown of upper second bicuspid (at age 38 years). The bottom of the gingival crevice has passed the cemento-enamel junction and is located on the cementum 0.5 mm. rootwise from the cemento-enamel junction. The gingival epithelium is intact. The depth of the crevice is zero. (×14.) A comparison of Figures 8-10 shows that, in permanent teeth just as in deciduous teeth (Figs. 5-7), the bottom of the crevice moves rootwise with advancing age.

epithelial attachment being united only with the cervical one fifth of the anatomic crown. At the age of 38 years, marked age changes have taken place: the tooth is abraded, the pulp chamber is small and secondary dentin has been deposited. The gingival crevice is located on the cementum approximately 0.5 mm. rootwise from the cemento-enamel junction.

Special attention should be called to the fact that, in all three stages, the depth of the crevice is practically zero and that the gingival epithelium is intact. I do not intend to go into the 15 year old discussion as to whether this gradual recession of the gingival tissues, or continued eruption of the tooth, whichever

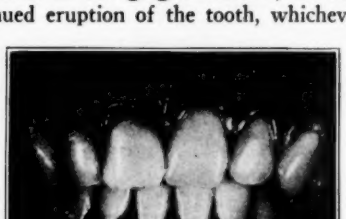

Fig. 11.—Right upper central incisor with porcelain jacket crown (in man, aged 22 years). The crown was made at 15 years, at that time replacing all of the enamel that was erupted and accessible. With advancing age, more enamel of all the teeth became exposed. Thus, an additional area of enamel was exposed rootwise from the margin of the jacket crown and is now visible above the porcelain.

you wish to call it, is physiologic or pathologic. I merely wish to say that ten or even five years ago such a discussion would have been fruitless because of the small number of good human specimens available at that time. Since then, dozens of shallow, intact human gingival crevices of persons of all ages have been studied microscopically, and the gradual rootward displacement of the bottom of the gingival crevice is so obvious in these specimens that it is hard to believe that this could be anything but a physiologic process.

The dental profession is beginning to realize the importance of these changes. An evidence of this is the papers and discussions on jacket crown preparation. Until recently, all rules for the preparation of an anterior tooth for a jacket crown were given without specific consideration of the age of the patient and of the associated position of the gingiva. In a recent paper by Oppice,[2] diagrams indicate plainly the difference between the position of the shoulder in a young and in an old patient, depending on the changing relationship between gingival tissues and tooth surface.

Figure 11 shows the upper anterior teeth of a man, aged 22. When the patient was 15 years old, he suffered an accident which resulted in the death of the pulp in the right upper central incisor and in a bad discoloration of the crown. The pulp canal was filled and a jacket crown was prepared which replaced all of the enamel accessible at that time. At present, seven years later, the jacket crown is still in perfect condition, but, rootwise from the margin of the jacket crown, there is visible about 1.5 mm. of markedly discolored enamel. The oral hygiene of the young man is excellent, and the free gingival margin of the right central incisor is at exactly the same level as that of the left incisor. The only explanation for the appearance of this discolored enamel is that, at the age when the jacket crown was prepared, the cervical portion of the enamel was still united with the labial gingival tissues.

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PROLONGED MODIFIED NITROUS OXIDE-OXYGEN ANESTHESIA; PSYCHOLOGIC AND TECHNICAL FACTORS IN ITS SUCCESSFUL APPLICATION IN MAJOR ORAL SURGERY*

By J. HOLDEN BECKWITH, D.D.S., Miami, Fla.

THE purpose of this paper is to present the principles of a modified technic for the administration of nitrous oxide and oxygen in major oral surgical operations.

It is the hope that this presentation may offer new ideas to those who have for many years used this anesthetic, and even more that it may open a new vista for the exodontist who is just beginning utilization of this agent. It is also hoped that the presentation of this method may help oral surgeons to avoid failures in this field, and may at the same time provide an effective answer to those dentists and physicians who have for many years claimed that prolonged nitrous oxide-oxygen anesthesia is impractical, almost impossible to maintain and harmful to the patient.

Successful use of this method over a period of twenty years has convinced me that the adverse criticisms of certain members of the medical and dental professions are without foundation, and thereby constitute a distinct impediment to the advancement of major oral surgery. Far from being impractical and dangerous, nitrous oxide-oxygen anesthesia, when properly administered, is not only innocuous, but is also a boon to both patient and operator.

From the beginning of civilization, all humanity has shunned pain, not necessarily from the physical inability to endure it, but from the mental strain and psychic shock of anticipation, as well as from the physical shock of operations performed without anesthesia. Anesthetics are the agents that have solved this problem.

As more surgical operations are performed in the mouth than in any other part of the body, a great responsibility rests on the dentist to perform these operations with a minimum of physical and mental discomfort. Especially is this true at present, when increasing nervous and mental stresses are taking their toll of the nervous energy of the public, driving them to demand this service.

All information obtainable today proves that a very small percentage of the population are having needed dental operations of all types performed. And since correct dental service is recognized as a fundamental factor in health, the dental profession must prepare itself to render the needed service, especially in the field of major and minor oral surgery, with regard to the comfort of the patient, if it is to continue to progress in a manner that will be in accord with the traditions of the profession. Dentists have been slow to perfect themselves in the technic of prolonged anesthesia. This statement is emphasized by the fact that

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in 1868, sixty-seven years ago, E. Willis Andres mixed oxygen with nitrous oxide, thus making prolonged anesthesia possible. He published accounts of a number of cases in which he obtained a nonasphyxial form of anesthesia by mixing oxygen with nitrous oxide. It was not until thirty-five years later that Hewitt, in England, and Teter, in America, urged the use of these agents in combination for long operations, and devised apparatus for controlling the proportions of the gases. Teter manufactured his first machine in 1908. McKesson began his study of anesthesia in 1906, and brought out his first machine in 1910. Since that time, Heidbrink and others have developed many machines. This process of evolution has, among other things, brought about the use of carbon dioxide as an aid in promoting respiration.

No matter what machine is used, the operator must have as the foundation of his technic a knowledge of nitrous oxide-oxygen administration, and be able to recognize the signs of anesthesia quickly and not become confused. It is generally accepted that nitrous oxide-oxygen is the safest anesthetic. It is also the anesthetic most rapidly assimilated in the blood stream, and it is this phenomenon that makes the agent difficult to administer. This fact makes it necessary for the anesthetist not only to master the technic of administration, but also to be able to respond to the changing signs of anesthesia promptly and with precision. The fullest refinement of technic comes only with actual experience.

The difficulties that must be overcome are numerous and varied. In the past, but few colleges have given adequate courses in nitrous oxide-oxygen anesthesia to either medical or dental students. They have given the impression that nitrous oxide-oxygen is for short, rapid anesthesia only and have underestimated its possibilities in their instruction to undergraduates. The instruction obtained after leaving college has usually been given by salesmen for manufacturers of nitrous oxide-oxygen machines, and these self-styled instructors have given the impression that all one has to do after purchasing a gas machine is to adjust a nasal inhaler, set the machine to deliver a certain percentage of nitrous oxide and oxygen, administer the mixture for a certain number of minutes, and then rely on speed, with very little attention to technic, for the removal of teeth.

Thousands of capable dentists, not being able to obtain proper instructions or information in books or in the colleges, have invested in various types of gas machines, only to be disappointed in their results. Their inexperience and faulty technic have created many difficulties, resulting either in their being unable to keep their patients asleep or in producing annoying deep narcosis, causing a struggle that has prevented satisfactory operating. These experiences have created fear and have brought loss of confidence, with the result that proper surgical anesthesia is seldom attained. Many dentists who are physically and temperamentally adapted for the practice of oral surgery could increase their practice and render their patients a valuable service if they would learn to administer nitrous oxide-oxygen with the same mastery that they have developed for other phases of dentistry.

Many patients stay away from the dental office until their teeth have become abscessed and the gingival tissue has become inflamed and painful. This situation causes a severe disturbance of the acid base equilibrium of the body, complicating the problem of surgical operations. In these cases especially, nitrous oxide-oxygen is the ideal anesthetic, owing its

safety and desirability to two main factors: lack of toxicity and unique flexibility. My chief aim has been to obtain the greatest amount of practical utility, and I have adopted those principles of technic that have proved to be the simplest and most natural, eschewing all needless efforts in the attempt to obtain satisfactory results.

In the past, there has been a difference of opinion as to the number of teeth that might properly be removed at one time. Today, with the establishment of success in the administration of nitrous oxide-oxygen, we believe that extracting one tooth at a sitting when several teeth are ultimately to be removed is just as absurd as removing one tonsil at a time.

With the great improvement in gas machines we have been able to develop a technic with nitrous oxide-oxygen that makes possible the successful utilization of this agent for any dental operation. It has been found necessary to develop a modified technic for nitrous oxide-oxygen administration that is different from the technic used in hospitals, and it has been found that this modified technic is the safest and most satisfactory one for use in oral operations. Not the least of its advantages is the elimination of the dread that laymen experience in having their teeth removed, and it thus conserves the health of our patients, and incidentally creates more work for all members of the profession. It is, therefore, a real duty to develop this method, and to educate patients to the advantages and comforts derived therefrom.

It has been difficult to impress the profession, as well as the laity, that prolonged anesthesia with nitrous oxide-oxygen can be given without producing any detrimental effect on the blood pressure or cardiac activities or on any of the vital organs of the body, and that impacted teeth can be removed and multiple extractions performed with little discomfort by one who has developed a definite technic.

It is now known that the longer the operation and the more exacting the surgical technic, the greater the need for nitrous oxide-oxygen, since there is no other anesthetic that so well protects the brain cells from shock, and at the same time produces no tissue damage or chemical change in any organ or cell. F. H. McMechan, editor of *Current Researches in Anesthesia and Analgesia,* writes, "Nitrous oxid anesthesia is selected in extractions and oral surgery, because it promotes the formation of the blood clot, decreases after-pain and reduces postoperative complications to a minimum."

The great majority of dental operations and oral surgical operations are performed on ambulatory patients, or those classified as a good risk. These patients, including the anemic, diabetic, tuberculous and cardiac, can be anesthetized successfully by a careful nitrous oxide-oxygen technic. The only difference in administration for such cases is the necessity for giving more oxygen and for carrying the patient slowly through the induction period, with no encroachment on free breathing.

The plethoric and alcoholic types are certainly the ones that cause the most difficulty. Such cases can be handled more satisfactorily with premedication, for every patient's mind must be put at ease, either by premedication or the power of suggestion, before an anesthetic can be successfully administered. Experience has shown that pentobarbital sodium (nembutal), which is a powerful sedative, administered fifteen minutes before the operation is a great help. This drug depresses the sympathetic cortex, the fear center of the brain, and does not excite the motor cortex, as do other well known barbiturates. We all know that no mat-

ter how much confidence one has in the operator, nearly all dental operations are attended with fear and apprehension. In these cases, it is necessary to use pure nitrous oxide with greater pressure through the induction period, giving the patient sufficient time to absorb it. The patient should be quickly anesthetized, but we should then spend two or three minutes obtaining complete saturation. It is better not to attempt to operate until one notices regular respiration, insensitiveness of the conjunctiva and quiet of the muscles, and then to begin operating very cautiously, watching for reflex signs. If these are present, more time should be spent in saturation, and the oxygen increased only enough to prolong the anesthesia, as these patients respond quickly to oxygen administration and tend to come out of the anesthesia.

Fear is the next important barrier to successful anesthesia. This is commonly found when physicians and dentists have advised patients never to take a general anesthetic. This advice, given through ignorance, jealousy or inexperience causes the patient great worry, and he always presents himself in a nervous frame of mind. In such case, it requires initiative and skill to inspire confidence in the merits of nitrous oxide-oxygen.

Many patients show resistance when nitrous oxide-oxygen anesthesia is suggested. This arises from a general anesthesia complex, brought about in many instances by the traditional custom of administering gas with no nurse or assistant. Under such circumstances, the patient often becomes conscious or semiconscious, before the operation is completed, retaining a nearly ineffaceable dread of gas. The patient's mental attitude is manifested favorably or unfavorably from the time he enters the reception room. It is the dentist's responsibility to so plan and systematize his office that patients may enter the operating room with no added fears. The sympathetic suggestions and kindness of a trained nurse at the time she is preparing the patient for the dentist's approach is of inestimable value. The dentist must not only explain to the patient what he may expect during the induction period, but must also impress on him the importance of his cooperation during the recovery period. It has been found that a few minutes of explanation as to what to expect in the induction and recovery periods are invaluable in overcoming excitability, suffocation, unpleasant dreams and combativeness. These have been found to be the cause of many criticisms of general anesthesia, and, for this reason, intelligent efforts to influence the psychologic reaction of the patient are of the utmost importance.

Suggestions may be divided into two distinct classes: the direct and the indirect. Direct suggestions are used before induction, such as, "I am going to give you a little nitrous oxide-oxygen. You will find it most pleasant, if you will relax, think of a pleasant subject and just breathe normally. When you awaken, you will feel a little gauze in your mouth. Please remain quiet until you can see clearly, then allow me to remove the gauze."

The indirect suggestions are used during the recovery period. Then the subconscious mind of the patient reacts to the power of suggestion, and the patient will actually do what you are suggesting. These statements should be made in a low tone close to the patient's ear; for example, we may say "That was a beautiful 200 yard drive." Usually, the patient will react, thinking he is actually playing golf. His first conscious statement will be something concerning a golf game. Through previous conversation, one can easily judge subjects that interest

the patient most. It is of the utmost consequence that strict respect for quietness be observed during the induction and recovery periods, as noises are greatly magnified during these stages of anesthesia.

The patient is so placed in the chair that when the mouth is open, the head and neck are in line with the chest. The chair is tilted backward so that the weight of the body will keep the buttocks in the angle of the seat, as respiration has been found to be least interfered with in this position. The head will not fall forward with relaxation of the neck muscles during anesthesia, especially when pressure is applied on the forehead. The knees should be uncrossed, and feet relaxed on the foot rest, the hands resting on the lap with fingers interlocked. If the head is out of position, the maximum freedom of opening of the air passages is impossible. It may be necessary to readjust the head rest during anesthesia. Straps are seldom needed, but, if used, they should be applied after the patient is unconscious, the operator being careful to place them over the forearms and across the pelvis. They are never placed over the chest, since they restrict breathing, interfering with anesthesia. A mouth prop that is not easily dislodged, and that does not interfere with the field of operation, should be inserted before the anesthetic is started to make certain that the patient can breathe freely. A Depass rubber prop of proper size seems to be ideal.

For many reasons, the anesthetic should be started with the face inhaler. This should never be applied directly in front of the patient, but should be placed gently on the right cheek and folded over the nose and mouth lightly. All anesthesia for oral operations should be started with the operator holding the face mask, for he has more influence on the patient's mental attitude during the period of induction.

The important procedures to observe at this time are the perfect placement of the face inhaler over the mouth and nose, regulating the exhaling valve so that there is no pressure against the patient's exhalation, warding off the sensation of choking and striving for an even flow of gases. We should never allow the patient to reach the excitable stage from too much pressure or develop the sensation of suffocation from low pressure. It is my chief aim to obtain regular inspiration and expiration during the induction period. The gases should be administered with slight pressure to aid the patient's breathing as the inspiratory impulse is much weaker than the expiratory. The anesthetist should maintain continued pressure for inspiration and reduce it for expiration. I use 100 per cent nitrous oxide with little pressure to begin induction, for all patients have a residual atmospheric oxygen present in the lungs, and this oxygen will dilute the initial nitrous oxide given. Nitrous oxide is then absorbed by the blood stream and again diluted by the oxygen present in the circulation. As the nitrous oxide gradually displaces this oxygen, anesthesia is induced, being sustained by supplying a certain percentage of oxygen. Owing to many abnormal influences, as in old age or in childhood, and to certain physical conditions wherein the absorption of nitrous oxide into the blood stream varies, there is no set standard for the percentage of gases.

A proper gas tension must be established and retained; for there is no proper anesthesia until a definite tension in the cells of the body is reached. A little time, thought and effort spent in obtaining this smooth phase of anesthesia will obviate many difficulties as prolonged anesthesia is approached. Normal anesthesia is obtained by a properly balanced mixture of nitrous oxide and oxygen, and when this

is attained, a machine-like regularity of breathing, a little faster than normal respiration, will be noted. The muscles become relaxed and there is a slight increase in pulse rate. There is little color variation in the average case. The anemic patient has no color change, but decided cyanosis is observed in the plethoric and alcoholic types. The pupils of the eyes become small or medium and fixed. The eyeballs roll slowly, the lids are slightly opened and the conjunctiva is insensitive to touch. At this stage of normal anesthesia, a change is made from the face inhaler to the nose inhaler. I find that using the McLaugham two-way switch gives better control of the even flowing gases.

At this time, normal anesthesia is continued into prolonged anesthesia. Perfect cooperation between operator and anesthetist is of vital importance. The instant the face inhaler is removed, the anesthetist should adjust the nose inhaler, while the operator is placing the pharyngeal pack. Deftness on the part of both means either success or failure, for no anesthetic can be properly prolonged with the nose inhaler without a perfectly placed pharyngeal pack. This is accomplished by placing the second finger in the mouth, drawing the tongue forward and placing a suitably sized pack, with string attached, in the throat to exclude all air, mucus and blood and to prevent foreign bodies from entering the pharynx as the operation proceeds. It is necessary to change this pharyngeal pack during the operation, as it becomes saturated and then fails to accomplish its purpose.

In major or minor oral surgery, there are only three stages of anesthesia that we should endeavor to control: the induction period, the operative period and the recovery period; for, as we know, if the operator causes no interference with the open air passage by putting too much pressure on the mandible, by propping the mouth open too wide or by interference from the pharyngeal pack, the anesthetist can carry any ambulatory patient through prolonged anesthesia. It is necessary to watch the oxygen supply carefully, as a variation of 1 per cent of oxygen in some patients will alter the plane of anesthesia. The depth of anesthesia is controlled by the proportions of oxygen and nitrous oxide administered. Therefore, an accurate interpretation of the signs presented is the only reliable guide for altering the mixture to carry the depth of narcosis required.

The anesthetist should train the ear to check the rate, the volume and the character of breathing, as these are most important signs. Irregularity of the rhythm of respiration is caused either by an internal impulse or through a mechanical interference by the operator. An expert anesthetist is a great help at this time, for he can quickly adjust the depth of the anesthesia, according to the seriousness of the operation. The dental surgeon must cooperate and use the utmost gentleness in handling the mandibular and pharyngeal packs so as not to force either of them too far backward, causing pressure on the pharynx. During the operative period, we should use sponges to keep the mouth as nearly free from blood as possible. If the blood becomes too saturated with nitrous oxide, the safest and quickest method of resuscitation is by forcing pure oxygen into the lungs. It should be administered with an apparatus so constructed as to partially inflate the lungs by means of a regulator valve so connected as to deliver oxygen directly from the cylinder. When this condition is corrected, if there are no mechanical obstructions, the patient returns to normal anesthesia, and the balance of this plane is maintained by adjusting the mixture of gases, with the thought always

that deep relaxation in dental operations is not required.

After completion of the operation on one side of the mouth, it is of the utmost importance to place a sponge over the bleeding area, with the rubber mouth prop directly against this. If the pharyngeal pack is saturated, it should be replaced. Such precautions prevent the blood from draining into air passages and thus causing irritation. This accuracy in the placing of the pharyngeal pack helps the anesthetist to give a smoother anesthetic, for it prevents mouth breathing.

It is difficult to produce a dangerously deep narcosis without pronounced asphyxia. Asphyxia is a broad term, which may include any grade of respiratory inadequacy from any condition that closes off the oxygen supply. One may determine this condition by noting the extra effort of the patient on inspiration, causing a labored breathing, twitching of the muscles or rigidity. Asphyxia may always be corrected by one or two direct oxygen inhalations, if the air passages are open. It is important to realize that only one or two direct oxygen inhalations are necessary. If too much oxygen is given, the patient will be brought into light anesthesia. Dr. McKesson has proved that all the blood of a patient may be saturated with oxygen in about twenty seconds.

Anoxemia may be produced even with a clear airway. This is a sign that the oxygen is insufficient to maintain the vital functions of heart and lungs. Cyanosis is no indication of anoxemia, for it may occur in the plethoric and alcoholic type before surgical anesthesia. In the anemic, a fatal oxygen deficiency can occur without cyanosis. It is important to observe other signs of the depth of anesthesia when cyanosis occurs.

We must emphasize the importance of a knowledge of the signs and symptoms of anesthesia, for fear may prohibit the induction of a narcosis of sufficient depth for the operative plane. Far worse, by not recognizing the signs of anesthesia, one may place the patient in a state of profound anesthesia. These irregular stages of anesthesia generally cause nausea.

Nausea is never experienced during the induction period. About 10 per cent is found to occur in prolonged anesthesia, caused by a fluxation of the anesthetic and changing the mixture of gases too suddenly, carrying the patient first too deeply and then too lightly. Also, it may be induced by allowing blood or mucus to pass into the stomach from an improperly placed pharyngeal pack. Ninety per cent of nausea is found in the profound stages, being caused by the contraction of the diaphragm downward against the stomach, producing an evacuation of its contents.

Impending nausea can easily be detected by the presence of a pale greenish hue, and cold perspiration over the forehead, followed by the patient's attempt to swallow. Retching then starts. Preventive measures should be applied at once. About 99 per cent of nausea can be avoided if these signs are detected early enough and if the anesthetist gives two or three direct inhalations of oxygen, while the assistant quickly places the thumb and two first fingers on the throat, massaging the muscles backward and upward. If this fails and vomiting results, the body should be tilted forward with the head down and the pharyngeal pack removed. This will expel the vomitus from the throat and mouth and will force the tongue forward. The patient is brought into light anesthesia, the nose inhaler examined, the pharyngeal pack replaced and the plane of operative anesthesia smoothed out by adjusting the mixture of gases.

Do not attempt to operate during any

abnormal stage. A few moments spent in smoothing out the plane of prolonged anesthesia will give the feeling of confidence that any dental or major oral surgery operation that would otherwise be deemed impossible can be successfully brought to its conclusion.

When the operation is completed, two methods are used to restore the patient to consciousness. The simplest method is to remove the inhaler, allowing the patient to inhale air. The second method consists in giving 100 per cent oxygen for several breaths to quickly restore consciousness.

During this period, even though we are not administering gases, it is necessary to watch the patient's breathing, seeing that the air passages are open. The success of the recovery period depends a great deal on quietness in the surgery, and an explanation to the patient before induction as to what to expect during recovery. I wish to stress the importance of direct and indirect suggestions; for what would be recognized in the minds of the operator as a successful prolonged anesthesia can be a failure in the mind of the patient if the recovery period is not controlled. In hypersensitive or nervous patients who make no effort to control themselves after the recovery period, I use a triple bromide preparation.

Following are some important contributing factors in failure and some solutions that I have found practical. First is the absence of psychic control of the patient. Since most patients are anesthetized without premedication, there is an enhanced necessity of instilling the confidence we have in nitrous oxide-oxygen by assured actions and by firm but kindly conversation, that the patient may drift into unconsciousness with the greatest degree of tranquillity.

It may be proper to again mention the fact that, after anesthesia has been induced and is being maintained, any slight change in the oxygen intake either through the adjustment of the gaseous mixture, by improper placing of the pharyngeal pack, by allowing oxygen from the air to be breathed through the mouth, by neglect of regulation of the expiratory valve of the inhaler or by holding the inhaler too lightly in contact with the skin, allowing air to be inhaled, will quickly and surely change the plane of anesthesia. Another important precaution to be observed is not to place this pack too far back as a cough reflex will be stimulated, sometimes resulting in gagging and perhaps vomiting.

A free and unobstructed airway must be maintained at every moment. The anesthetist must be alert and watchful for any obstruction. An exchange of expired gases for the fresh gases of inspiration can produce anoxemia. This calls for reestablishing proper inspiration, and an immediate temporary change of the oxygen intake. With the varying types of patients that present themselves for prolonged anesthesia, it behooves us to have a machine capable of producing the desired gaseous mixture under regulated pressure.

The mind must be properly trained to recognize instantly the signs and symptoms of the various planes of anesthesia. If a moment is spent in making sure what the condition is, the level of anesthesia will have changed so completely that much adjusting of the mixture will be necessary, and the smooth plane of anesthesia will be lost. Fear of nitrous oxide-oxygen anesthesia must be conquered.

We must not be impulsive or expect to induce instantly a satisfactory anesthesia in every patient. We have many abnormal cases to deal with: the neurotic and the alcoholic type, with the difference in time needed to produce absorbability

of the anesthetic. If difficulties are encountered in one or more forms, a little time spent in smoothing out the plane of anesthesia will make the prolonged anesthesia successful when otherwise success might be deemed impossible.

If we master the modified method of prolonged anesthesia with nitrous oxide-oxygen, it will not be necessary to add other agents to accomplish the desired results, for prolonged anesthesia has a definite place in dentistry, opening a broader and more extensive field of usefulness.

Any ambulatory patient can be given a successful prolonged anesthesia if the technic is followed and the confidence that we have in nitrous oxide-oxygen anesthesia is instilled in the patient. It is possible to attain prolonged anesthesia, and it is practical and is not harmful to maintain.

THEORETICAL CONSIDERATIONS OF CARBOHYDRATE DEGRADATION IN RELATION TO DENTAL CARIES*

By LEONARD S. FOSDICK, Ph.D., and HAROLD L. HANSEN, Ph.D., Chicago, Ill.

DENTAL caries has been an enigma for years. Despite the large volume of material obtained from both clinical and laboratory studies on the subject, we are still at a loss to explain the various details of the process concerned in the decalcification of enamel and subsequent destruction of the entire tooth. Theories bearing on the subject have been advanced from time to time, but these theories, together with the facts advanced in their support, fail to give a clear picture of the nature of this disease.

At the present time, the workers in the field of research on caries may be divided into two groups, although there is some indication of a rapprochement between workers of the two schools of thought. In the first place, there is that group of investigators who have elaborated on the chemicobacterial theory first advanced by Miller,[1] Black[2] and Williams.[3] Among the investigators who have contributed data in support of this theory are Howe,[4] McIntosh,[5] Bunzell[6] and Bödecker.[7] Bunting and his coworkers[8] during the past few years have been investigating the environmental factors in

*From the Chemistry Department, Northwestern University Dental School.

*Read before the Section on Therapeutics, Pathology and Research at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

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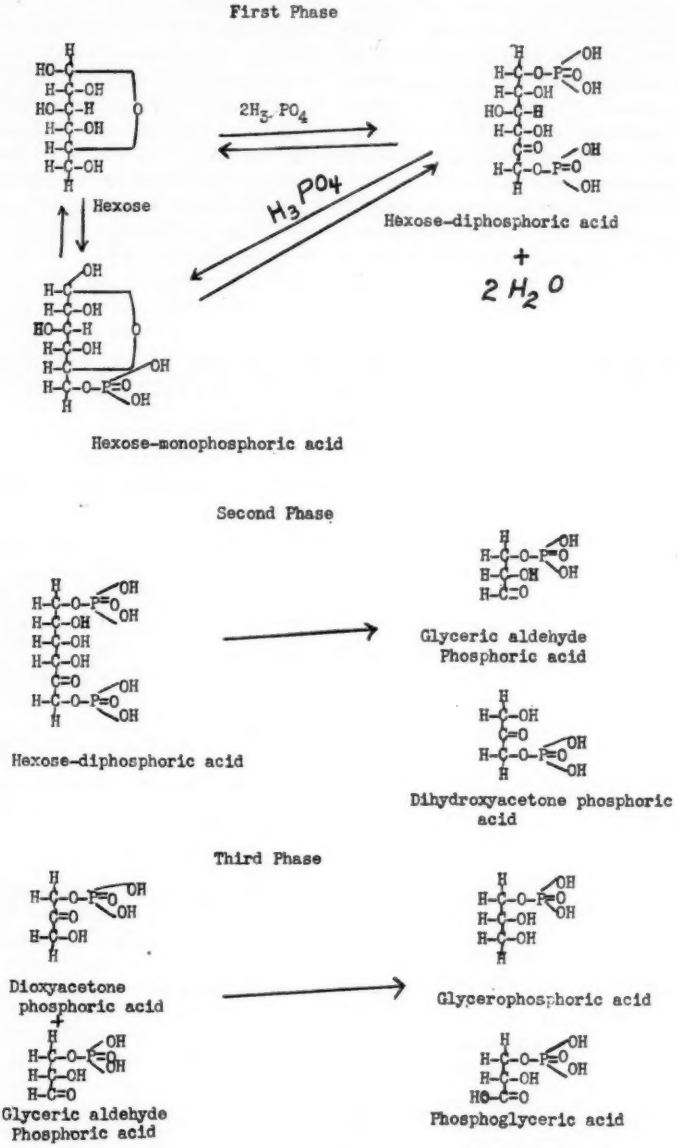

First Phase
Hexose
$2H_3PO_4$
H_3PO_4
Hexose-diphosphoric acid
+
$2H_2O$
Hexose-monophosphoric acid
Second Phase
Hexose-diphosphoric acid
Glyceric aldehyde Phosphoric acid
Dihydroxyacetone phosphoric acid
Third Phase
Dioxyacetone phosphoric acid
+
Glyceric aldehyde Phosphoric acid
Glycerophosphoric acid
Phosphoglyceric acid

Figure 1.

caries. As a result of these investigations, Bunting has come to the conclusion that *Bacillus acidophilus* is the organism most concerned in the production of the carious lesion and that a high carbohydrate diet is a contributory cause in that such a diet promotes the growth of this acid-producing organism. In the second school of thought, in which the names of Rosebury,[9] Mellanby[10] and Rumsey[11] frequently appear, the general opinion is that diet is the controlling factor in caries. The manner in which diet may change susceptibility to caries is not clear. There is the possibility that diet may alter the environmental condition of the teeth by changes produced in the saliva; or there is a possibility, according to some workers in the field, that changes in diet produce corresponding changes in the teeth themselves and thus alter the susceptibility to caries.

In a consideration of the immediate cause of dental caries, it is generally conceded that a high carbohydrate diet may play an important rôle in this disease. The way in which carbohydrate produces this effect is not entirely clear. The investigators of the chemicobacterial school believe that the action of micro-organisms on carbohydrate material adhering to the teeth results in the formation of acids, which dissolve the enamel.

Such considerations have prompted attempts to determine the amount of acid

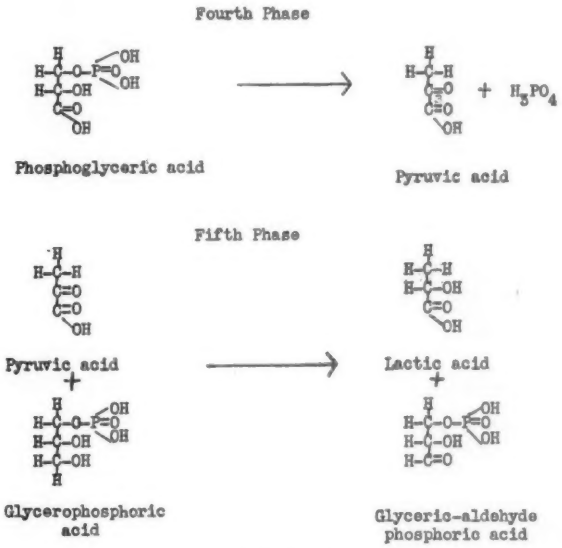


Figure 2.

9. Rosebury, Theodor, and Karshan, Maxwell: J. D. Res., 11:121 (Feb.) 1931. Rosebury, Theodor; Linton, R. W., and Buchbinder, Leon: J. D. Res., 9:529 (Aug.) 1929.

10. Mellanby, May, and Pattison, C. L.: Brit. M. J., 1:507 (March 19) 1932. Mellanby, May: Brit. D. J., 45:545 (May 1) 1924; Lancet, 2:767 (Dec. 7) 1918.

11. Rumsey, C. F.: Brit. D. J., 42:49 (Jan. 15) 1921.

or the p_H necessary to decalcify enamel[12] and the conditions under which such acidity may be produced. In no case had an attempt been made to show just how this acid is formed or the reactions that take place during its formation.

It has been known for many years that fermentation is not produced by the organisms themselves but by products excreted by or contained in these organisms.[13] In the field of sugar chemistry and fermentation, much work has been done on the degradation of sugars both by yeast and by the tissues of animals. In both types of carbohydrate degradation, there is evidence that the reactions run a similar course and to a large extent are identical. The researches of Harden,[14] Young, [15] Robison,[16] Meyerhof,[17] Nilsson,[18] Neuberg[19] and Embden[20] show that, in the tissue of animals, the first step in sugar degradation is the formation by enzymes of a hexosemonophosphate or a hexosediphosphate and that in fermentation by yeast or by acid-producing enzymes, the reaction is the same.

These workers have proposed various reactions for the products of sugar deg-

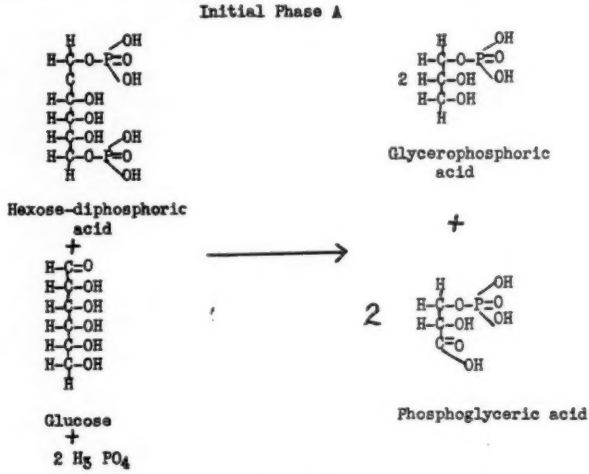


Figure 3.

12. Enright, J. J.; Friesell, H. E., and Trescher, M. O.: J. D. Res., 12:759 (Oct.) 1932. Holt, L. E., Jr.; La Mer, V. K., and Chown, H. B.: J. Biol. Chem., 64:509 (July) 1925. Benedict, H. C., and Kanthak, F. F.: J. D. Res., 12:277 (April) 1932.

13. Buchner, E.: Ber. d. deutsche chem. ges., 30:110, 117, 1897; 31:568, 1898.

14. Harden, A.: Alcoholic Fermentation, London: Longmans Green & Co., 1923.

15. Young, W. J.: Proc. Chem. Soc., 23:65, 1907.

16. Robison, R.: Significance of Phosphoric Esters in Metabolism, New York City: New York University Press, 1933.

17. Meyerhof, D., and Kiessling, W.: Biochem. Ztschr., 267:313, 1933.

18. Nilsson, Tek, Tid. Appl. C. Kemi., 64, 49, 1934.

19. Neuberg, C., and Leibowitz, J.: Biochem. Ztschr., 193:237, 1928.

20. Embden, G.; Deuticke, H. J., and Kraft, G.: Klin. Wchnschr., 12:213 (Feb. 11) 1933.

radation and now have a comprehensive picture. The degradation of carbohydrates to lactic acid in the body is clearly described by Embden. (Figs. 1-2.)

The action of yeast on carbohydrates has been described by Meyerhof. (Figs. 3-4.)

As can be seen by these equations, the formation of a hexosephosphate is the first step in both reactions. The fourth phase of sugar metabolism in muscle and reaction B of yeast fermentation is inhibited by fluorides. In both cases, when fluorides are present, lactic acid or alcohol is not produced.

We have performed some experiments[21] in which powdered human enamel was shaken with saliva containing glucose for definite periods of time at body temperature. The saliva was analyzed for calcium and phosphate before and after shaking. It was found that when the samples of saliva with enamel were shaken for eighteen hours, all samples, both from caries susceptible and caries immune patients, has dissolved large quantities of enamel. When the saliva was preserved with sodium fluoride, there was no solution of the enamel and, in many cases, there was precipitation of calcium and phosphate ions from the saliva. This shows that the saliva is normally saturated with calcium and phosphate ions, but that when fermentation occurs, the acids produced

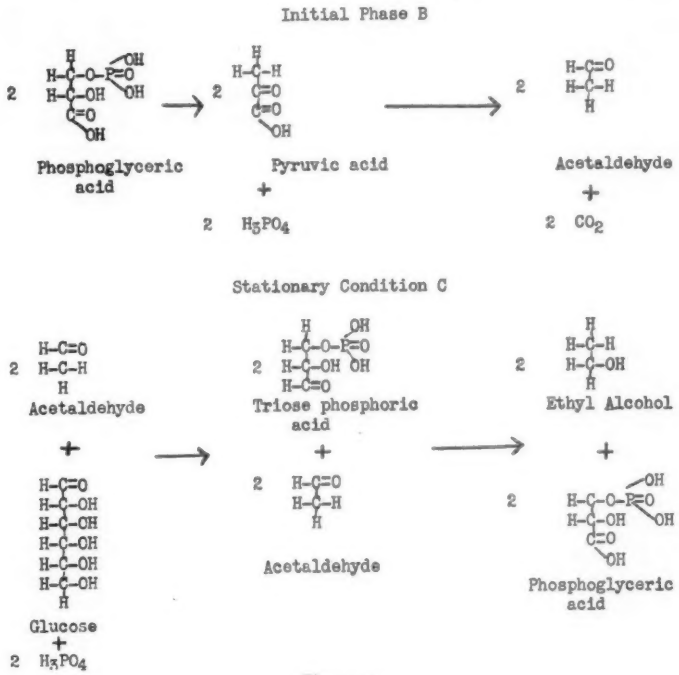


Figure 4.

21. Unpublished data.

dissolve enamel. When fermentation was prevented by the presence of sodium fluoride, there was no solution of dental enamel. In this connection, it is interesting to speculate on the possible relationship of fluorides in fermentation and the reduced susceptibility of mottled teeth to decay.

We observed that when unpreserved saliva had been shaken with enamel for about eighteen hours, an odor characteristic of yeast was produced. When the mixture was cultured, yeast organisms in large numbers were found.

A review of the literature on atypical yeast fermentation,[22] reveals the fact that the presence of calcium salts and phosphates in a fermentation mixture causes the formation of acids rather than alcohol.

In view of this fact, pure cultures of yeast obtained from the mouth were allowed to act in a mixture of saliva, glucose and powdered enamel. In some cases, synthetic saliva was used. In all cases, dental enamel was dissolved, the average amount in twenty cases being equivalent to 22 mg. of calcium per hundred cubic centimeters in eighteen hours. The same procedure was tried with certain other organisms found in the mouth. It was noted that the yeast organisms caused the solution of a larger amount of enamel than did any other organism tried and that, under these experimental conditions, *Bacillus acidophilus* produced no effect.

Since these results with *Bacillus acidophilus* do not conform with any of the other work done in connection with this organism in relation to caries, it was decided to try the effect of a mixture of yeast and *Bacillus acidophilus*. Under the experimental conditions used before, eight tests gave an average decalcification equivalent to 45 mg. of calcium per hundred cubic centimeters. This indicates symbiosis of the two types of organisms. Work is now under way to determine the rôle of various mouth organisms, singly and in combination, in the decalcification of enamel.

References to yeast in the dental literature are extremely scanty. Hadley,[23] working with Bunting, noted the presence of yeast organisms. No conclusions were drawn as to their effect in the saliva.

Although somewhat unusual, it is not surprising that the yeast organism can produce acids from carbohydrates. There is abundant evidence that these organisms can be made to produce so-called abnormal fermentation by a variety of means. A striking example of this is the production of large quantities of glycerol by the addition of sodium bisulfite to the cultures. The added bisulfite transforms the intermediate acetaldehyde to the well-known addition compound, and this in turn brings about an accumulation of glycerophosphoric acid. The latter compound is then transformed to glycerol. In a similar manner, the calcium salts of the saliva and the enamel may produce abnormal fermentation by acting on pyruvic acid and somehow preventing its decarboxylation. The reductases in yeast then could transform the keto compound to the hydroxy compound, lactic acid. The mechanism postulated above may well be subject to revision, but we have succeeded in the isolation of lactic acid.

The fact that *Bacillus acidophilus* increases the formation of lactic acid when grown with yeast and produces no acid under our experimental conditions in eighteen hours indicates that, in the chain of reactions involved in acid fermentation, there may be certain steps that are

22. Kostychev, S.: Ztschr. Physiol. Chem., 146:276, 1925. Nod, F. F.: Chem. Met. Eng., 28:351, 1923. Bolcato, V.: Boll. d. Ist. scero-terap. milanese, 10:1 (Jan.) 1931. Gior. Chim. ind. e. applicanta, 13, 69, 1931.

23. Hadley, Faith P.: J. D. Res., 13:415 (Oct.) 1933.

more rapid than others and that some of these reaction stages are promoted by the presence of yeast and others by that of *Bacillus acidophilus*.

SUMMARY

1. There are a series of reactions in the degradation of carbohydrates by the enzymes of yeast and of tissue.

2. Certain data indicate the importance of yeast in dental caries.

3. A combination of yeast and *Bacillus acidophilus* produces more acid than either one alone.

RADICAL URANOPLASTY (LIMBERG): A NEW OPERATION FOR CLOSURE OF A CLEFT PALATE*

By LOUIS SCHULTZ, D.D.S., M.D., Chicago, Ill.

THE literature dealing with the surgical correction of cleft palate is quite voluminous; which justifies the thought that, so far, the ideal operation has not been developed.

The number of operations suggested and practiced is large, and there is no agreement as to the age at which surgery had best be invoked for the greatest good of the patient.

For the sake of convenience, let us divide the groups of operators into two main ones on the basis of their practice: (1) the group of surgeons who advocate operation during the first two years of life; that is, before the baby learns to speak, and (2) those who prefer some later period. Both groups are well represented. Among the operators advocating surgical interference early in the baby's life are Wolff, Garretson, Ziegler, Helbing, Lane, Brophy and Blair. Among those choosing an age anywhere between 2 and 16 years are Veau, Kirschner, Kuester, Lexer, LaMonier, Mikulicz, Sauerbruch, Vaughn, Deubner, Payr, Hildebrand, Roux and Limberg.

The earliest attempt at surgical closure probably was made by LaMonier, in 1764. Recognizing the great need of help for these unfortunates, many others tried similar corrections, among them Eustache, in 1799, Von Graefe, in 1817, Roux, in 1819, Warren, of Boston, in 1820, and also Dieffenbach, Liston, Sir William Fergusson, Sedillot, Pancoast, William Garretson, Erdmann, Billroth and Trilet. Velpeau first suggested early operation, while Reeves, in 1861, noting the great spread of the maxillary bones in cleft palates, suggested approximation of those bones.

The operation, or a modification of it, probably most generally used, is one originated by Von Langenbeck, but, in many cases, the soft palate is left taut and short and hence there is little, if any, improvement in function.

No doubt, everyone in this audience knows of the contribution made to cleft palate surgery by the late Truman W. Brophy, who originated the molding of the maxillae from the abnormal position into one of approximation of the anterior portion and the reduction to normal

*Read before the Section on Oral Surgery, Radiology and Anesthesia at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 20, 1935.

relationship with the mandible posteriorly. He recommended that this operation be performed as soon as the baby's condition warranted it. A child so treated later comes to the operation for closure of the palate with a narrower cleft, in some cases very much narrower, than it was before this operation; which facilitates the operation.

Another distinguished surgeon who has contributed a great deal to the improvement of cleft palate surgery in particular, and to oral and plastic surgery in general, is Vilray P. Blair, of St. Louis. To mention only one among many contributions, he gave us the two-step Von Langenbeck operation for very wide clefts, by which much wider flaps are obtained than in the one-step operation.

In 1926, it was my good fortune to meet Alexander Limberg, director of the polyclinic in Leningrad, Russia, on the occasion of my report to the International Dental Congress in Philadelphia of a case of bilateral resection of the mandible for prognathism. Dr. Limberg asked me for a reprint of the paper just referred to, promising in turn to send me a reprint of an operation for the correction of cleft palate recently developed by Ernst and Halle. The reprint was an illustrated outline similar to Dr. Limberg's description with illustrations as given by him in discussing the symposium on cleft palate at the International Dental Congress.[1]

Since 1926, then, I have practiced a modification of that operation in nearly all of my cases, for all tension of the flaps is abolished and a greater length of the soft palate is assured. The modification consists in the omission of two points, stressed by Ernst and Halle: (1) the mesopharyngoconstriction, which, so far, I have not found necessary in my cases, and (2) the application of a celluloid plate covering teeth and palate and extending to the end of the uvula, because I do not believe that such an appliance can keep the wound clean.

The trend in late years has been to use a technic which will give greater length and more flexibility to the palate than are obtained by the Von Langenbeck operation. Such efforts are represented by the so-called push-back operation, advocated by Dorrance of Philadelphia; (2) the free dissection of palatal flaps and stretching of the vessels and nerve issuing from the great palatine foramen, as demonstrated by Blair, and (3) the actual setting back of the soft palate and the soft tissues of the hard palate, using Lwow and Ganzer incisions as proposed by Ernst and Halle. To these, Dr. Limberg has added another and more effective one. Knowledge of this operation came to me after I obtained a translation of it from a copy of "A Manual of Practical Surgery" by Girgolov, Martynov and Fedorov in Russian, which he sent me. Hence, it is my privilege to outline Dr. Limberg's operation which to my knowledge has not so far been published in this country. He calls it radical uranoplasty.[2]

Preoperatively, he recommends partial resection of the tonsil in certain cases, for he performs his operation in children of from 2½ to 3 years and up. A protective celluloid plate is prepared a few days before the operation, the function of speech is analyzed and the usual preoperative cleansing of the oral cavity is carried out before the child comes to operation.

A child 7 to 8 years or older is operated on under local anesthesia, the pa-

1. Limberg, Alexander: New Method of Plastic Lengthening of Mandible in Unilateral Microgenia and Asymmetry of Face, J.A.D.A., 15:851 (May) 1928.

2. Martynov and Fedorov: Manual of Practical Surgery, 3:43-57, 1933.

tient's head resting upon the surgeon's knees. The aspirator works constantly to obviate in large measure the use of sponges.

Dr. Limberg describes different incisions for full clefts through the alveolar process, narrow clefts and wide ones. I shall limit myself to a description of cleft of the soft and part of the hard palate.

INCISIONS IN CLEFT OF SOFT PALATE AND PART OF HARD PALATE

An incision is carried through the edge of the fissure on each side, forward, and ending near the lingual aspect of the incisor teeth. A transverse incision a few millimeters in front of the beginning of the cleft connects the two incisions just described. Lateral incisions begin at the anterior end of the first incisions made and are carried along the lingual surface of the palate close to the gingivae. The foregoing description shows that he does not use the Lwow-Ganzer incision as recommended in the Ernst and Halle operation.

The palatine mucoperiosteal flaps are raised on each side to the great palatine foramen. They are turned backward to expose the entire denuded area including the nervovascular bundle issuing from the foramen. This bundle is now separated from the edge of the foramen except on its posterior and external aspect; nor is the separation carried into the region of the minor palatine foramina. By means of a flat chisel, and with a few taps of the mallet, the medial part of the posterior edge of the great palatine foramen is broken. The bundle is now pushed laterally and the chisel is moved along the posterior edge of the foramen as far outward as possible. Again, a few taps of the mallet, and the posterior edge of the palatine foramen is broken off. This piece is now moved inward and backward toward the nasopharynx, and any sharp protrusions are removed; which permits the nervovascular bundle to be freely moved medially and posteriorly.

To constrict the mesopharynx, an incision (Dieffenbach-Ernst) is carried through the mucosa and submucosa only, extending from the upper cuspid posteriorly to the last lower molar. The anteromedial edge of the internal pterygoid muscle is now exposed with a wide elevator, and the loose connective tissue is carefully separated until the tendon and muscle fibers of the anterior edge of the pterygoid muscle are reached. Care is recommended not to injure the capsule of the muscle or the lingual nerve and vessels which lie laterally.

With a gauze sponge or with a finger, the lateral wall of the mesopharynx is now separated from the internal pterygoid muscle posteriorly to the posterior pharyngeal wall, then up and down as far as possible. To free the anterior portion of the soft palate, an interlaminar osteotomy is performed. A narrow chisel or osteotome is placed externally to the palatine foramen, with one angle resting on the bone. The handle of the chisel is over the bicuspid region of the other side. A few gentle taps break through the cortical plate of the alveolar process. Using this point as a foothold, the handle of the chisel is now moved inward to the central incisors in such a way that the cutting end of the chisel would, after perforating the pyramidal process of the palate bone, pass through the middle part of the pterygoid fissure into the pterygoid fossa occupied by the pedicle of the internal pterygoid muscle. The handle of the chisel is now from 0.5 to 1 cm. behind the cutting edge of the incisors. The direction of the osteotomy is controlled by palpating the top of the hook of the pterygoid process, which should be to the inner side of the chisel.

In this position, the chisel is tapped twice with the mallet, a straight elevator is put in the bone slit made and, the operator pressing medially or jerking, the internal pterygoid process is broken off as deeply as possible. It is then moved medially. The inner end of the pterygoid muscle is split into two parts, the inner part being displaced medially. This wound is now filled with a small gauze sponge (danger: the internal carotid in small children). The approximation, the length of the flaps and the shape of the palate are now checked up. The palate is of the right length if it permits approximating the base of the uvula with the posterior wall of the pharynx. The flaps of the hard palate are united by one layer of interrupted catgut. A turning in of the epithelial edge is prevented by one or two mattress sutures.

The soft palate presents three layers of tissue, each of which must be united with interrupted suture of iodized catgut. No. 00. First, two or three interrupted sutures are placed in the nasal mucous membrane of the soft palate, and two to three in the muscles and in the oral mucous membrane, from 6 to 8 mm. apart. When the end of the uvula is reached, it is pushed downward and as many more sutures are placed on the nasal side of the soft palate as necessary. The medial edges of the anterior flaps are now sutured with interrupted and mattress sutures. The anterior ends of the palatal flaps are sutured to the posterior end of the anterior flap. This will prevent displacement of the posterior flaps anteriorly. In cases of complete cleft of the palate and alveolar ridge, the anterior end of the palatal flap remains free and is supported by the celluloid plate. Nonabsorbable material cannot be used in this operation at all.

The celluloid plate is now adjusted. Shortening and curving of the posterior end may be necessary to prevent pressure and decubitus. The edges of the plate are curved with hot pliers.

PLACING OF THE SPONGES

Temporary sponges are replaced with iodoform gauze. The lateral wounds in the mesopharynx are packed tightly; those in the lateral wounds of the hard palate, loosely. The edges of the hard palate flaps are pressed to the exposed bone surface. One flat loose sponge is made to cover the entire surface of the soft and hard palate, being held in place by the celluloid plate. Children with deciduous teeth have a special outfit to keep the celluloid plate in place.

POSTOPERATIVE TREATMENT

The celluloid plate gives the patient a chance for absolute rest. The first change of dressing is made on the tenth to twelfth day; hence, crying, involuntary swallowing, etc., associated with change of dressing, occur after the edges of the cleft have united and the lateral wounds are covered with granulation tissue. On removal of the celluloid plate and the sponge immediately above it, a fresh scar presents itself, the surface of the palate being covered with desquamated epithelium. It is cleansed with hydrogen peroxide 3 per cent and liberally rinsed with warm water. Now the iodoform sponges are replaced with xeroform sponges. Subsequent changes of dressing are made every two or three days until the lateral wounds of the mesopharynx are filled with granulation tissue, usually a matter of from twenty to twenty-five days after the first dressing. The posterior part of the celluloid plate is covered in its center with a layer of black guttapercha in order to elevate the soft palate by gradual pressure.

The temperature may rise to 100.4 F. during the first few days after the opera-

tion. Pain in the pharynx on the second or third day is controlled by a hot compress. In small children, grave respiratory embarrassment may occur owing to swelling of the pharynx and approximation of the dorsum of the tongue to the palate. To relieve it, the tongue is pressed down and a wide rubber tube reaching to the end of the celluloid plate is placed in the mouth. Iodoform poisoning may occur between the time of operation and that of the first dressing, particularly in small children. The symptoms are unusual excitement, pallor, anorexia, nausea and sometimes vomiting. After the first change of dressing, the picture clears. Soft and semisolid food without limitation is ordered. There is loss of weight, which is very quickly regained. Massage of the soft palate is ordered one and one-half to two months after the operation.

RESULTS AND COMPLICATIONS

Results.—In Limberg's series of 140 cases of radical uranoplasty, complete healing by first intention occurred in 92 per cent of cases. Small defects from 0.5 to 1 cm. long were noted in 8 per cent except for one case in which the defect was 2 cm. long. In 90 per cent of cases, good or moderate closure of the nasopharyngeal tract was obtained. Death from anesthesia during the first twenty-four hours occurred in two cases.

Complications in Retrotransposition.—In 12 per cent of cases, there occurred in the anterior part of the hard palate and on the lateral sides of the flap small penetrating slits without a lumen or defects not more than from 2 to 4 mm. in diameter. A small slough occurred in one case at the end of a flap damaged by a transverse scar the result of a previous unsuccessful Langenbeck operation. In spite of this, there was no defect in this place.

Complications After Mesopharyngoconstriction.—Limited movement of the lower jaw due to the scars may be present for several months and the patient should be so informed in the beginning. Normal mobility, which gradually reestablishes itself, may be hastened by the application of a wooden wedge placed between the teeth several times a day for from ten to fifteen minutes each time.

Treatment of Complications.—If, at the first change of dressing, a defect in the region of the soft palate is noticed a few centimeters in length, closure by interrupted sutures will not succeed. The flaps must be approximated by a special suture. Silkworm gut is carried with a needle from the nasopharynx through the lateral wall of the pharynx into the lateral deep wounds. Small celluloid plates are placed at its ends and lead weights. The flaps are freshened and coaptation sutures are applied. The special suture is then used to secure adequate tension by proper adjustment of the flattened weights. It is advisable to have an extra free lead weight in reserve under the flattened ones, which, on subsequent changes of dressing, could be fixed to a new part of the thread if additional tension is necessary. The ends of the thread are not cut off, but are placed between the sponges.

The location of the plates on the surface perpendicular to the direction of tension considerably decreases the danger of decubitus and of a transverse cut of the flaps by the thread. After complete healing of the edges, and not before the eighth or ninth day, this special suture is removed by cutting the silkworm gut between the celluloid plate and the lead weight.

All remaining small defects of the scar in the anterior part of the hard palate or around the alveolar process can be corrected gradually by small plastic operations consisting of the transposition of

small flaps of the palatine mucosa. Several months must elapse before such operations are attempted.

Unfortunately, I have not had a case suitable for this operation since I received the translated description; but, though without experience, I differ, first, as regards the partial resection of tonsils before the operation. Tonsils which call for removal should be removed *in toto,* for it is a well known fact that a tonsillotomy leaves stumps, which have a more deleterious influence as regards the metabolism than do the entire glands. I would recommend a tonsillectomy in such cases.

As to the protective celluloid plate, I stated my position when discussing the Ernst and Halle operation. Local anesthesia I too favor very much, but I would hesitate to employ it on a child under 10 or, better, 12 years of age, for not all children of that age even present suitable cases.

Dr. Limberg's incisions about the anterior part of the palate I prefer to the Lwow-Ganzer type as recommended by Ernst and Halle because the palatal flaps abut the posterior margin of the gums left anteriorly to the cleft, a sliding forward of those flaps, which occurs sometimes if the Lwow-Ganzer incisions are used, being thus prevented.

Limberg's method of freeing the nervovascular bundle issuing from the great palatine foramen makes a strong appeal, so strong in fact that I am greatly tempted to employ it on the next robust child of 16 months or thereabouts coming into my hands for palatal closure; for I can see a greater advantage accruing from this technic than if the stretching of the bundle is relied on to give the desired freedom and length to the velum. By the same token, I favor mesopharyngoconstriction in a cleft sufficiently wide to warrant it, for it seems reasonable that by that technic adequate function of Jacobson's valve may be secured, without which the child cannot speak.

With more caution, I would approach Limberg's interlaminar osteotomy. To disturb the origin of the tensor tendon and its relation to the orifice of the eustachian tube seems unnecessary, as a liberation of the tendon by breaking off the hamular process will accomplish all that fracturing the medial lamina of the pterygoid process will do, and is so much simpler than the Limberg technic.

My experience with the Ernst and Halle operation bears out the statement that nonabsorbable coaptation sutures, such as horsehair, may be used successfully; in fact, that is the kind I always use, but I do not cover them with a plate.

If sponges are used to pack wounds of such size that iodoform poisoning may result, I would suggest the use of xeroform gauze instead of iodoform. There is then no period of distress for the patient due to the toxic effects of the iodoform. Unless mesopharyngoconstriction is carried out, the use of iodoform gauze will produce no toxic symptoms.

To relieve small children of grave respiratory conditions, I suggest a metal airway. As to diet, patients can use soft and semisolid food with impunity with a celluloid plate in place, but with the wound uncovered. I keep patients on a liquid diet until union has taken place and there is no appreciable loss of weight.

Dr. Limberg's technic is one worthy of earnest consideration and careful study.

And now I wish to illustrate what may be accomplished with the help of an orthodontist and by use of the Ernst and Halle operation.

REPORT OF CASE

In the summer of 1931, a girl, aged 10 years, was brought in with the following history: She had a congenital cleft

of the left side of the palate and a cleft lip, for the correction of which she was operated on thirteen times during babyhood. The only result of all these operations was a nice closure of the lip. The palate, widely separated from lip to uvula, presented a rather hopeless picture. Obviously, molding of the bones had not been attempted when she was small and the fissure was so wide that she had been refused surgical treatment in a number of local clinics. The patient was greatly depressed and had an inferiority complex. A glance showed that no ordinary intraoral operation, not even the Ernst and Halle, could close that enormous cleft. But the patient looked so pitiful that I could not bear the thought of her going through life wearing an obturator. After considerable study, I told her that if she was willing to go through whatever treatment was found necessary until a good result was achieved, I would undertake to close the palate. Her mental picture changed immediately and she was happy at once.

The first operation was performed in August, 1931. An incision was made through the external plate of the right maxilla with chisel and mallet beginning at the alveolar ridge in the second bicuspid region and terminating at the inner canthus of the eye. The upper jaw was then broken along that line and approximation obtained of the short left fragment and the end of what was left of the premaxillary bone, for some of that had previously been cut off. The bones were freshened where they now met by trimming of the external plates and were wired in position, but there was no bony union.

Since the patient lives in Evanston, I referred her to Dr. McGuire, an orthodontist of that city, in October of the same year, having arranged with him to move the lateral halves of the maxilla medially enough to make it possible to cover the remaining fissure with what little palatal tissue there was. This he did, beginning in October, 1931, and finishing in July, 1933. Dr. McGuire's report is appended.

During July, 1933, I again freshened the bone ends and wired them, and also made mucoperiosteal flaps and closed the region from the lip to the incisive foramen. An opening extending from under the lip into the nose was also closed at that time; but both operations failed.

In September of the same year, I performed a uranoplasty, using a modified Ernst and Halle technic. Again I closed the vestibular defect, and again failure was the result. Three days after the operation, I was shocked to find that the patient had removed all of the sutures that she could pick out, but the flaps were in apposition and healed all the way to the tip of the uvula. Meantime, I discovered that there was between the bone-ends only fibrous tissue, which would not serve my purpose.

In March, 1934, I again freshened the bone-ends and approximated them, having arranged with Dr. McGuire to secure immobilization by means of a wire which kept the parts together and under a little pressure. Again I closed the vestibular defect and again that failed; but this time bony union was obtained between the two fragments.

In July of last year, the patient was ready for expansion of the maxilla all around. Much expanding was needed to bring the upper anterior teeth, which now were far inside the lower ones, and the posterior teeth, which had been moved from a position buccally to the lower ones to one of complete lingual relation, into normal occlusion. Dr. McGuire accomplished this in six months. As a result of his efforts and because of the bony union secured by my last opera-

tion, the patient now has an alveolar bony ridge, or one which will become bony in time, about an inch and a half long, which she never had before.

January 9 of this year, I again closed the vestibular defect, and this time it healed. I also closed the defect resulting from a lack of tissue anterior to the flaps, and that remained closed for one week. As a result, the child now has a very small opening in the hard palate, which I shall close in due time, at the same time correcting the defect in the left nostril, which is too large and in which there is too much thickening of the ala. An examination of the patient barely reveals the remains of the lateral incisions made when I attempted to close this last defect, and the hard palate is very thick. It is all scar tissue, and hence is very poor in blood supply and very stiff. To these last two conditions, I attribute the failure to heal after a full week's contact. Yet when the patient speaks, one realizes that scars in the hard palate are of no consequence at all. What is of utmost importance is that, by the Ernst and Halle operation, a long soft palate was secured, and later, as the bones were expanded to bring the teeth into normal relation, the soft palate developed, until there was a very satisfactory fully functioning palate and the remarkable ability to speak perfectly without any speech training.

Orthodontic Assistance in a Case of Cleft Palate*

During the summer of 1931, Dr. Schultz called to my attention the case of cleft palate which he has just described, and asked me to assist him from the orthodontic standpoint in the correction of the case. Through the interest and cooperation of a parent teacher organization in Evanston, we were able to arrange for hospitalization of the patient.

*By J. C. McGuire, D.D.S., Evanston, Ill.

September 29, I took modeling compound impressions of the mouth and referred the patient to Dr. Root for roentgenograms. There were missing from the upper arch the right cuspid, the left lateral incisor and one of the left bicuspids. The segments of the maxilla had spread until the span from the buccal surface of one first molar to the buccal surface of the opposite first molar was a distance of 65 mm. or $2\frac{3}{4}$ inches.

Mastication was extremely difficult, being effected only by thrusting the mandible to the left side and gaining occlusion of the first permanent molars on that side. When the muscles were at rest and the mandible was in what seemed to be centric occlusion, the lingual surfaces of the upper first permanent molars were in contact with or striking the buccal surfaces of the lower first permanent molars; which caused the cleft to grow wider and wider.

My problem was to approximate the two lateral segments of the maxilla sufficiently that Dr. Schultz would feel safe in attempting a closure of the soft tissues across what was then an extraordinarily wide gap or cleft.

Practically all the anchorage to be had on either side of the upper arch was provided by the first permanent molars. For these molars, I constructed gold crowns, and, on the lingual aspect of these crowns, I soldered half round tubes in vertical position, using a lingual arch size 0.038 to carry these molars lingually bodily.

Care had to be exercised to prevent strangulation of the pulps of these molars and also to be sure that the bone was being carried along with the teeth.

To facilitate this procedure and prevent the interference of the lower molars, which was due to their position linguad from the upper molars, I constructed crowns for these lower molars and, at the occlusobuccal angle, soldered buccal pro-

jections so that when the patient closed her mouth, the lingual cusps of the upper molars rested on these planes or projections.

On the buccal surface of the lower crowns, I also soldered the curvilinear tubes for the ribbon arch, using a ribbon arch wire to control the buccolingual placement of the lower molars.

The crowns for the four molars were cemented in place, October 23, and the upper lingual arch wire was placed in position. October 27, the lower ribbon arch wire was placed in position.

The lower molars were actually tipped buccally during the first few weeks to prevent the patient, in thrusting the mandible laterally, from closing beyond the planes I had constructed on the lower molar crowns and to prevent the lower molars from being tipped or carried lingually ahead of the upper molars.

A few days after the lingual upper arch wire was placed, I began application of light force to the upper molars to carry the buccal segments of the maxilla toward the median line.

In February, 1932, crowns on the lower molars were removed and replaced with swaged bands and the ribbon arch was used to keep the lower molars in upright position and to carry them lingually along with the lingual movement of the upper molars.

This process was continued during the next few months, the patient being seen two or three times a month until Dec. 9, 1932. At this time, the arch wires and crowns were removed, the teeth cleaned and impressions taken. The distance between the buccal surfaces of the upper molars had been reduced from 65 to 52 mm., or one half inch.

As Dr. Schultz decided that the gap should be reduced still farther, the crowns were recemented on the upper molars and the arch replaced, Jan. 13, 1933. (Incidentally, the patient returned, January 23, with the arch wire broken, and impressions had to be taken and a new arch made.) I continued the process of approximating these lateral segments until the last of June, when the distance between the buccal surfaces of the molars had been reduced to 45 mm., or a reduction of four-fifths inch. Further surgical work was done the first week in July. I then allowed the case to rest for a number of weeks.

When it was found that bony union had not taken place, I fitted bands on the upper incisors and constructed a bar to engage the anterior bands and the upper left molar, using light traction for a few weeks to bring these parts closer together. March 5, Dr. Schultz operated again.

With the bands in place on the teeth, and while the patient was still under the influence of the anesthetic, we forcibly carried the parts into complete apposition, and placed the bar and wired it securely in position. In May, 1934, the bar was removed.

In June, I placed a labial ribbon arch on the upper teeth and began bringing the buccal segments toward normal position. The upper incisors, which had been in lingual position these many months, were carried out to labial position.

The case at present is resting. From the orthodontic and esthetic standpoint, there is yet much to be done. I intend soon to institute orthodontic treatment, aline the remaining teeth as nearly as possible, construct some type of retainer supplying the missing teeth and fill out the lines of the face as nearly as possible.

MULTIPLE CHONDROMA: REPORT OF CASE*

By L. P. HENNEBERGER, D.D.S., and L. W. BIMESTEFER, D.D.S., Baltimore, Md.

History.—H., a colored man, aged 32, came in the dental clinic of the Baltimore City Hospitals, for the extraction of badly broken down teeth, with the following history: At 17 years of age, owing to trauma, a large bruise occurred on his right leg. Following this, large cartilaginous growths developed, which were diagnosed as multiple chondroma. During a period of years, these tumors developed

Fig. 1.—Abnormal growth of cartilage composing chondroma. Comparison of the little finger with the others reveals the enlargement of the other fingers.

rather slowly. At the age of 31, the right leg was amputated owing to this large growth, which weighed 52 pounds. During this time, the right hand also had become involved, as can be seen in Figure 1. The left hand is partially involved, and at present is being treated with radium. Associated with the multiple chondroma are the hemangiomas (blood vessel tumors).

Oral Examination.—A tumor, possibly an angiochondroma, about the size of a 5-cent piece, and containing fibrous tissue and many blood vessels, was seen on the mucous membrane of the lip. (Fig. 2.) MacCallum says: "In the cartilaginous tumor, however, the tissue is in relatively small districts well supplied with nourishment from abundant blood vessels which accompany its fibrous stoma. The intercellular substance is more variable in consistence and less dense than that of normal cartilage, and often shows a distinctly fibrillar stoma." On the palate, there appeared three or four smaller tumors, which were red and were hard on palpation.

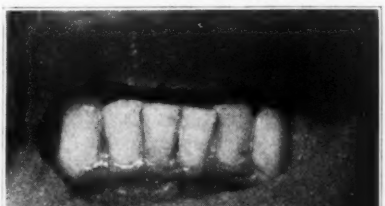


Fig. 2.—Possible angiochondroma, bright red, hard on palpation and richly supplied with blood vessels.

COMMENT

The possible etiology of the tumors of the lip and palate is trauma, most likely biting the lip, or scraping of the palate by abrasive foods.

The blood red appearance of the tumors in the palate can be explained by the ex-

*From the Dental Clinic, Baltimore City Hospitals.

cessive development of blood vessels around the tumor. Virchow and von Recklinghausen stated that the excessive development of blood vessels is of primary influence in the metastasis and development of the tumors.

The majority of chondromas occur in early life, about puberty. The multiple chondroma is congential and may be hereditary. These tumors may appear at birth. The patient has two children, 2 and 3 years old, one of whom had chondromas at birth. These tumors were removed and there has been no recurrence.

Virchow and von Recklinghausen have shown that rickets is an important factor in the disturbance of growth of bone that leads to chondroma formation.

ESKIMO AND INDIAN FIELD STUDIES IN ALASKA AND CANADA*

By WESTON A. PRICE, D.D.S., M.S., F.A.C.D., Cleveland, Ohio

THE relationship between dental caries, physical degeneration, lowered defense for disease and facial and dental deformities has apparently not been recognized or the factors therein defined. Data will be presented in this communication which throw light on these factors and on means for their control.

In an investigation to ascertain the rôle of nutrition in the etiology of dental caries, modern civilization's universal expression of degeneration, my field studies have also included the recording of data which relate to facial development, the arrangement of the teeth in the dental arches, resistance to disease and associated problems. Since many of the primitive races have had a high immunity to dental caries, in striking contrast with modern civilization, an effort has been made to study remnants of racial stocks whose isolation has preserved them from modernization. Among these have been included Eskimos in Alaska and the Indians in northern and central Canada in various stages of modernization, the study noting particularly the changing factors in the environment just at the point where the normal high immunity is lost. The data routinely studied have included the examination of each individual tooth, recording the location of dental caries when present, missing teeth, anomalies in growth, irregularities of the teeth in the arches and abnormal relationships between the dental arches. Both normal and irregular facial expression and dentition were recorded photographically and the latter frequently also by impression taking. Samples of saliva were obtained for chemical analysis and, in special cases, samples of blood. In order to evaluate the influence of nutrition, samples of various foods were obtained for chemical analysis and data recorded as to the proportion of the various foods eaten.

Ales Hrdlicka, curator, Division of Physical Anthropology, the Smithsonian Institution, assisted me in the selection of districts for making studies in western Alaska. For reaching the less modern-

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Sixth Annual Session of the American Dental Association, St. Paul, Minn., August, 1934.

ized Eskimos of the lower Kuskokwim, an airplane was chartered at Anchorage and used for moving from place to place through central and western Alaska to the mouth of the Kuskokwim River and northward. This gave an opportunity to make contact with some quite primitive groups who were using exceedingly little if any of the modern foods. The more modernized Eskimos as found at Bethel and some other settlements were studied for comparison. Many of these were living quite largely on modern foods, which were made available by the yearly visit of a government supply boat. At the mouth of the Kuskokwim River, a large group was examined that had gathered there for fishing. They were largely from the vicinity of Nelson Island. Fishing groups from the Tundra were studied on the island opposite Bethel.

Eskimo and Indian boys and girls were studied in the government school at Eklutna near Anchorage and at the Jesse Lee Mission Home at Seward. These children had been collected from as far north at Pt. Barrow, west through the Aleutian Islands and throughout central and southern Alaska. The native diet of western Alaska, as well as that of the Pacific coast of southern Alaska and of British Columbia, had been largely provided by the animal life of the sea. This was supplemented with some native roots, edible kelp and grasses, with practically no cereals and fruits except a few cranberries.

For comparison with the Pacific coast foods, it was very important to reach isolated groups of Indians inside the Rocky Mountain Divide. This was accomplished by using a river boat from Wrangell up the Stikine River to the end of navigation at Telegraph Creek and then across the Rocky Mountain Divide over an exceedingly difficult trail; which was accomplished by truck to the headwaters of the Dease and Liard Rivers, the latter a branch of the MacKenzie. From this point, we proceeded down stream in a powered scow to the Liard Hudson Bay Post on the Liard River. This is the last of three Hudson Bay Posts in this interior. The Indians of this district are nontreaty nomads living in tents and bark shelters in the summer and log shelters in the winter. They were sufficiently primitive that most of them had never seen a white woman before seeing Mrs. Price. Their diet consisted almost entirely of wild game, supplemented only occasionally with fish, there being no running salmon in these waters. The local fish are chiefly pike and white fish. They obtain some of the white fish in the winter by spearing through the ice. Their principal food is moose, supplemented with mountain goat, mountain sheep, caribou and small animals. Practically all of the organs and glands are eaten, as well as the marrow. By studying these people from within their isolated district outward as we returned toward civilization, we were able to note those conditions which had been modified by their first contact. They exchange furs chiefly for modern clothing, traps, fire arms and ammunition. Their hunting grounds are often hundreds of miles in various directions from the posts and their trips to the posts are infrequent, usually occurring only once or twice a year. This made it impossible for them to carry back to their hunting grounds any considerable quantity of modern foods. The Indians who remain in close proximity to the posts were able to obtain imported foods throughout most of the year. These consisted of the inexpensive foods that would stand shipping and storing without spoiling, chiefly flour, sugar and various sweetened foods, dried foods, polished rice and tea.

Similarly, groups of Indians were

studied at various of the coast towns, including Indian reservations on the Skeena River at Prince Rupert, also in the interior at Winnipeg Lake and between James Bay and Lake Superior. Highly modernized groups of Indians were studied in southern Ontario and in New York State.

In all, 800 persons were examined and approximately 22,000 teeth. For the most primitive groups of Eskimos, the incidence of dental caries was 0.09 per cent, or one tooth per thousand teeth examined. For the least modernized of the Indians in the northern interior, the incidence of caries was zero, for, in three groups of seventy-six persons with 2,144 teeth, not a single tooth was found to have been attacked by dental caries. In eighty-seven persons in four groups, only four teeth had been attacked by caries, or 0.16 per cent. For the Eskimos at the point of contact with modern civilization at Bethel and vicinity, the incidence of dental caries was 13 per cent of the teeth examined. For the Indians at the point of contact with modernization, the incidence of dental caries was found to be 21.5 per cent of the teeth examined. For each of these races at the point of liberal contact with modern civilization, the incidence of caries increased to an involvement of from 30 to 50 per cent of all the teeth. These figures are in accord with my data previously presented for some other races.

A critical study of the children at the point of contact with modern civilization revealed striking disturbances in physical development, particularly of the middle and lower third of the face. Not one single case of facial deformity or typical marked irregularity of the teeth or dental arches was found among the more primitive Eskimos or more primitive Indians; whereas, in all modernized communities, many cases revealed some phases of these disturbances. A study of the parents at the point of recent contact with modern civilization revealed that they had normal arches and normal facial development. In a single generation in contact with the foods of modern civilization, chiefly white flour and sugar products, there was marked change in the relation of the dental arches both to each other and to the remainder of the face. While these persons usually suffered from dental caries, the severity of the deformity was not in direct proportion to the caries. My investigations have revealed data that relate immunity and susceptibility to dental caries directly to nutrition. Persons who left their isolated native districts and placed themselves in contact with the foods of modern civilization for six months or more were often attacked by tooth decay, particularly during the growth period. The teeth were often badly wrecked in two years' time. In some cases, when these people went back to their native foods, the active caries ceased entirely and they again continued to have immunity. These persons did not have evidence of nutritional disturbance as expressed by deformity of the face or dental arches. While they were on their native foods, no overload was found to be adequate to break the normal high immunity of the isolated Eskimos and Indians, not even pregnancy and lactation or the period of rapid growth in children. When they reduced their protective native foods, these two groups had more rampant decay than other groups. We are accordingly concerned to find new facts on the etiology of dental caries and facial deformity.

In nearly all persons suffering from a lack of development in the middle third of the face, the capacity for ventilation through the nares has been physically reduced and many of them are mouth breathers. The nostrils are abnormally

small and the base of the nose narrow.

By far the most frequently found facial expression of nutritional deficiency involves the lack of development of both the middle and lower thirds of the face producing deformity of both dental arches. A typical case is seen in Figure 1, in which the right lateral incisors and first bicuspids are nearly touching. The cuspids are erupting outside the arch. The lower teeth are irregular.

Not a single case of irregularity in the

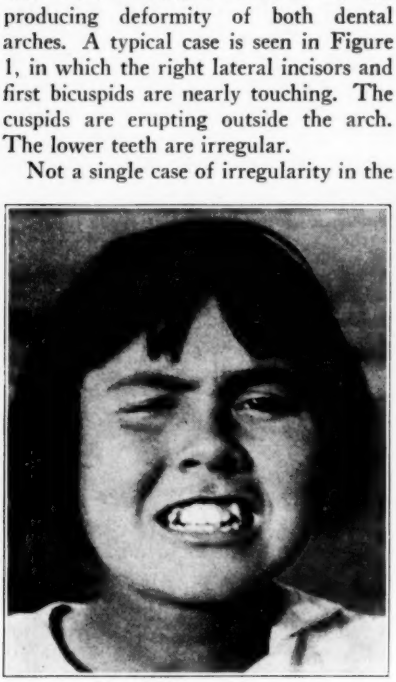


Fig. 1.—Case in which both the middle and the lower third of the face are underdeveloped. This is one of the most commonly seen types.

interrelationship of the two arches or the teeth in the arches was found among the most primitive Eskimos, except the presence, in a few cases, of supernumerary teeth. At the point of contact with modern civilization, where the mothers had displaced part of the native foods with modern foods during gestation and lactation and the children were using the modern foods in considerable part during the period of infancy and childhood, practically every case showed typical evidences of disturbed development.

Among the Indians inside the divide, living nomadic lives in northern British Columbia and the Yukon Territory and whose diet was limited almost entirely to wild game, the dental arches were normally developed in all of the adults and young people studied.

A typical case is shown in Figure 2, in which both the middle and lower thirds of the face have been retarded in devel-

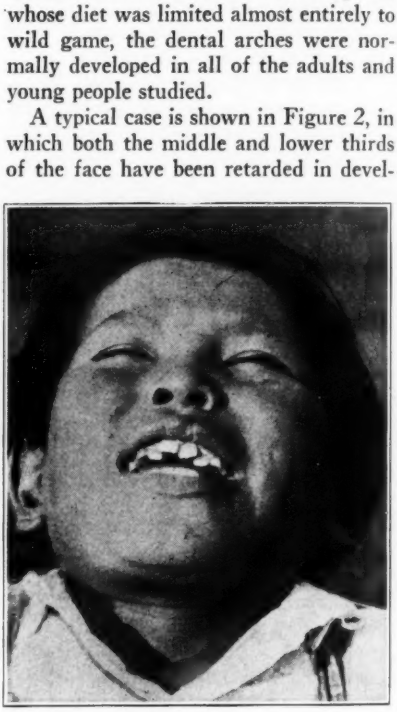


Fig. 2.—Typical irregularity of dental arches of Indians seen after adoption of modern foods. In this case, the middle third of the face is involved.

opment. The nostrils are small and the base of the nose is narrow.

In most cases, the lateral incisors develop inside the line of the arch, with the cuspids well outside. A few exceptions to this are found. A case is shown in Figure 3 in which the lateral incisors are being rotated outward by the first bicuspid. There is no room on either side for the developing cuspid, which in this class of

case often is directed forward and palatally inside the arch.

This developmental disturbance of the Eskimos and Indians has been found to occur when the nutritional change was from a predominance of the animal life of the sea on the part of the Eskimos and from a predominance of the animal life of the land on the part of the Indians, to the foods introduced by modern civilization, chiefly white flour and sugar products, which displaced part of the native natural foods.

Fig. 3.—Extreme deformity of dental arches involving both middle and lower third of face.

A logical question is whether a similar effect would be produced when changing from other diets containing, for example, cereals. We have light on this from my field studies in Switzerland among the isolated groups in the protection of the upper valleys, and the people in the Outer Hebrides in isolated parts of the Isle of Lewis and the Isle of Harris, which I have previously reported.[1]

1. Price, W. A.: Why Dental Caries with Modern Civilizations? D. Digest, 39:94 (March), 147 (April), 205 (May), 225 (June), 266 (July), 299 (Aug.) 1933.

A striking illustration is shown in two family groups of children, one from Scalpay, in the Isle of Harris, where the food was almost entirely limited to sea foods, and oat products. These children had practically complete immunity to dental caries, there being only 1 per cent of the teeth affected. The nostrils are broad and the dental arches are excellent. In contrast with this was a family of children on the Isle of Bardsey off the northwest coast of Wales. The children in both groups are Gallic and both speak the Gallic language. The latter group were living almost entirely on modern imported foods largely white flour and sweet foods. Every one was suffering from rampant tooth decay even to the 3-year-olds. On this island, 27.6 per cent of the teeth studied showed dental caries. Every child in this group was a mouth breather, which none of the Harris group children were. The nostrils were pinched and there was lack of development of the middle and lower thirds of the face. It is of interest and deeply significant that tuberculosis was rampant on the latter island as well as on the mainland, from which this and other families had been transported by the government to repopulate the island because it had been so largely depopulated by tuberculosis.

While it is not ordinarily feasible to make experiments on human beings with various types of deficiency diets with the intention of producing deformities as we readily do with animals, we can frequently find groups of persons living on specially deficient diets some of which had been used with the expectation that they would adequately meet human demands.

At this time, many fads regarding nutrition are being generously lauded by their exponents. A characteristic type is the emphasis being placed on the relation of acid to base forming factors in

the foods on the theory that much of modern illness is due to undue acidity of the system. It is accordingly not only instructive from the standpoint of science, but also a matter of great importance regarding physical welfare that data concerning such nutritional programs be studied and made available.

The following case, that of a girl aged 16, illustrates such a study. The characteristic of the nutrition as reported in detail by the mother was based upon its so-called defensive qualities in that all acid-producing foods such as cereals and meats were largely excluded and the diet was restricted to those foods that are strongly basic in chemical composition. This girl had marked underdevelopment of the middle third of the face amounting to a considerable deformity. It was for the correction and improvement of this, if possible, that she was presented for study. This included a consideration of the causative factors, such as the mother's nutrition during gestation and lactation and the child's food during infancy and childhood.

Among the important problems involved is the question as to whether a disturbed development of the bones of the face represents a latent process and one which can be resumed at a later date than that in which the growth should normally have taken place. The problem of deformity of the dental arch is so common and serious that an entire division of the dental profession has been built up for the purpose of correcting as far as possible by physical means these physical deformities and disturbances of the function of mastication. This procedure has had limited applicability to the correction of gross facial deformity such as an incomplete development of either the middle or lower third of the face or both. It has, in other words, been limited largely to correction of the position of the teeth in the arches and in part to correction of the relationship of one dental arch to the other. Little effort has been made to achieve the completion of the normal development, nor has this been deemed possible. In connection with these investigations, studies have been made to ascertain whether and to what extent this might be accomplished by a reinforcement of the nutrition. After the young woman had been on a special nutritional program for the purpose of stimulating growth for one year, there was evident a very marked building forward of the middle and lower thirds of the face, which strongly suggests that the condition was largely one of retarded development due to lack of available materials. As in the case of lowered resistance to infection and reduced function of special tissues and organs, there was greatly increased efficiency of the total human mechanism, both in the process of normal functioning and in the building and repair of all tissues. This growth was directly related to the available quantity of activating and tissue building materials in proportion to the heat and energy providing factors in the food.

In many of the groups studied, an early effect of a moderate nutritional deficiency was a tendency to an end-to-end bite of the upper lateral incisors on the lower with a reduced overlap of the central incisors. Along the Canadian and Alaskan coasts, several cases were found in which this particular divergence from normal occurred in both the parents and the children, probably indicating not an inheritance factor, but a similar exposure to stress in the two generations. The question as to how many generations would have to be involved to make this an "inherited character" probably can-

not be stated very definitely. It is an interesting problem for the geneticists.

Simultaneously, another major problem has been studied. While it has been known that primitive Eskimos and Indians when modernized succumb rapidly to tuberculosis and suffer severely from arthritis, this has generally been explained on the basis of a lack of an inherited immunity because of the ancestry not having built up an immunity through both exposure and successful combat. In my study of the Eskimos and Indians who were suffering from tuberculosis, I have found those making a poor fight to be living largely at present or in the past on the foods of our modern civilization. When persons were studied from the standpoint of the presence or absence of evidence of a nutritional deficiency in infancy and early childhood, the data obtained revealed a very great increase in the percentage of persons who were breaking with tuberculosis among those who had been injured in infancy by nutritional stress as indicated by facial deformity. For example, in the study of twenty persons under 21 years of age, who constituted all the patients in the government hospital at Juneau, suffering from pulmonary tuberculosis, 100 per cent were found to have deformity of the dental arches, indicating an injury not only to the mechanisms of physical growth but also to the development of the chemical laboratory for providing the defensive weapons for combating infection.

These are not problems which chiefly concern particular cases. My examinations made in a municipal tuberculosis sanitarium of Cleveland revealed that, in forty-three successive cases of tuberculosis at various ages, forty gave evidence of nutritional injury in the early growth period.

I was informed by an Indian reputed to be a high authority on the Indian languages of northwestern America that none of the Indian languages had a word for rheumatism or arthritis and that his people did not suffer much from these diseases until they were touched by modern civilization. That this affection is on the increase in modern civilization seems clearly established by the data being developed in many states. Massachusetts alone is now reported by its health department to have 150,000 cases of arthritis. Similarly, appendicitis, heart disease and a number of other degenerative processes are clearly on the increase. It is of interest that these increases are occurring in spite of the best efforts of modern clinical science, hospitalization and prenatal care. These affections are largely accepted as being incurable diseases and not subject to more than palliative treatment.

In the light of newer knowledge, we are concerned to know to what extent these so-called diseases just referred to may be symptoms rather than unit diseases. On the basis of the foregoing and other findings, I have established nutritional programs that provide the chemical characteristics found to obtain in the protective nutrition of the Eskimos and Indians and of other isolated groups. Diets are provided which furnish at least 2 gm. each of phosphorus and calcium per day in suitable form, together with an adequate quantity of the other minerals, and these all suitably reinforced with the fat soluble activators such as are provided for the Indians and Eskimos and other physically efficient groups in their native foods. By these means, we are now able, as previously reported, to control dental caries regardless of its being very rampant.

The chemical analysis of the foods of

a typical menu as used by the Eskimos is shown in Table 1 and as used by primitive Indians in Table 2. The analysis of a typical displacing diet for these two groups is shown in Table 3. It will be seen from the summary shown in Table 4 that the minerals in this displacing diet were from 30 to 97 per cent lower than in the native diets. The Eskimos and Indians suddenly placed in contact with modern civilization were particularly unfortunate in that the two new foods that were most readily provided, namely, white flour products and sugar products, are two of the least nutritious from both a mineral and a vitamin standpoint of all the foods of modern civilization. It is of particular interest that the demineralized flours from which also wheat embryo has been largely removed are not adequate to maintain life in either larger animals or in the small flour grubs which tend to infest the ground entire wheat products.

Investigation of physical anthropologists have revealed physical degeneration coincident with national decadence. The investigations of Hooton and his associates at the Pecos Pueblo have revealed an increase in arthritic processes and skeletal degeneration associated with the decline of that group. It has been noted by many observers that the skeletons of children and invalids disintegrate much more rapidly than those with the more perfect physical development. It is ap-

TABLE 1.—DISTRIBUTION OF ACTIVATORS AND MINERALS IN TYPICAL MENU OF PRIMITIVE ESKIMOS

Calories	Food	Fat Soluble Activators	Calcium	Phosphorus	Iron	Magnesium	Copper	Iodine
1,700	Salmon	+++	1.24	2.68	0.048	0.710	0.022	0.000072
200	Seal oil	++++						0.000015
100	Plants, roots	+	0.49	1.40	0.035	0.26	0.002	0.000016
500	Sea animals	++	0.36	1.02	0.014	0.21	0.0065	0.000021
500	Caribou	++	0.05	0.60	0.003	0.093	0.0007	0.000007
3,000		+++	2.14	5.70	0.100	1.273	0.0312	0.000131

TABLE 2.—DISTRIBUTION OF ACTIVATORS AND MINERALS IN TYPICAL MENU OF PRIMITIVE INDIANS

Calories	Food	Fat Soluble Activators	Calcium	Phosphorus	Iron	Magnesium	Copper	Iodine
2,500	Flesh of wild game	++	0.58	4.16	0.13	0.35	0.0033	0.000014
400	Glands and organs	++++	0.10	1.49	0.025	0.066	0.0189	0.0000087
100	Vegetables, barks and roots	+	1.62	0.96	0.031	0.266	0.0032	0.0000013
3,000		+++	2.30	6.61	0.186	0.682	0.0254	0.0000240

propriate to note in this connection the progressively accelerating rate of many of the degenerative processes in current civilization. It is also significant that these increasing rates are not uniformly distributed throughout a continent. In the United States, heart disease is increasing most rapidly in the eastern maritime states and along the Great Lakes. Similarly, arthritis makes progressive advances, reaching one in twenty-five of the population.

My investigations on the monthly variations in milk fat vitamins as received twice a month from many districts throughout the world are now being carried into the seventh successive year. When these data are arranged on a monthly basis for succeeding years, the annual curves harmonize in a general way. All communities show a seasonal cycle which is not in accord with the sunshine cycle but is in accord with the plant growth cycle. When these curves are associated with curves for heart disease and pneumonia for various districts, as, for example, when the United States and Canada are divided into sixteen districts of many thousand square miles each, the mortality and activator curves

TABLE 3.—MINERAL DISTRIBUTION IN TYPICAL MENU OF MODERNIZED INDIANS AND ESKIMOS

Calories	Food	Fat Soluble Activators	Calcium	Phosphorus	Iron	Magnesium	Copper	Iodine
1,200	Bannock bread	—	0.13	0.42	0.003	0.09	0.0144	0.00000006
1,200	Sugar, jam, syrup	—	0.15	0.24	0.06		0.0009	0.0000006
100	Chocolate, coffee	—	0.02	0.07	0.0004			
300	Meat	++	0.03	0.33	0.0027	0.032	0.0004	0.0000016
100	Vegetables	+	0.06	0.08	0.001	0.022	0.0010	0.0000005
100	Vegetable fats	—						
3,000		+	0.39	1.14	0.0671	0.144	0.0167	0.00000276

TABLE 4.—COMPARISON OF DIETS OF CARIES IMMUNE AND SUSCEPTIBLE

Groups	Fat Soluble Vitamins	Calcium	Phosphorus	Iron	Magnesium	Copper	Iodine
I Immune Eskimos	High	2.14	5.70	0.100	1.27	0.0312	0.000131
II Susceptible Eskimos	Low	0.39	1.14	0.067	0.16	0.0167	0.00000276
Reduction	Marked	1.75	4.56	0.033	1.11	0.0145	0.00012824
Reduction (per cent)		81.8	80.0	30.0	86.6	46.6	97.8
*	*		*		*		*
III Immune Indians	High	2.30	6.61	0.186	0.68	0.0254	0.0000240
IV Susceptible Indians	Low	0.39	1.14	0.067	0.16	0.0167	0.00000276
Reduction	Marked	1.91	5.47	0.119	0.52	0.0087	0.00002124
Reduction (per cent)		83.0	82.7	63.9	76.4	34.0	88.5

are, as previously reported,[2] always in opposite phase. When the fat soluble activators of the dairy products are high, the deaths from heart disease and pneumonia are low, and vice versa. In those districts with the highest mean levels for the fat soluble activators, there is disclosed the lowest mean levels for heart disease, and vice versa. It is also of significance that the government statistics for abandoned farms show an important relationship to low vitamin foods and high mortality levels. The common cause for the abandonment of the farms is that they have "run out." Since there is only provided enough phosphorus in most of the surface soils for about 100 crops of wheat, rye or corn, and in much of the land less than this, it will be understood why this element should readily become exhausted or depleted. Many other minerals required by the body, and some of them in very small quantities, may also be involved in this depletion, particularly copper and iodine.

I have shown how greatly the minerals were found to be reduced in the menus of the Eskimos and Indians when they displaced a considerable portion of their native foods with those of modern civilization. This displacement seems to be based upon one of the most fundamental of animal instincts, namely, the sense of need for foods, being expressed as hunger. With the native foods of the earth, animal life, including man, has had usually only to eat those foods near at hand to obtain a sufficiently well-balanced ration with regard to both energy products and building materials adequate for both growth and repair. This has been completely changed by modern civilization, since man has learned how to modify the natural foods or has obtained greater latitude in food selection. Appetite still determines the quantity of food eaten; but since appetite applies almost entirely to energy producing foods, it has not been a safe guide. This probably has been a leading factor in the decadence of various races. This was brought out in my conversation with the Eskimos and Indians at the point of contact with modern civilization. When I asked them why they like our modern foods better than theirs, they said because they did not need to eat so much to keep themselves warm or to do their work. These people break faster than people of modern civilization and more sharply, in large part because they do not have so large a variety of such good substitutes, for their native foods. They do not get our whole grains, dairy products, fruits and vegetables. We cannot live on what we send them, and both we and they can be saved by better foods than our modern civilizations use.

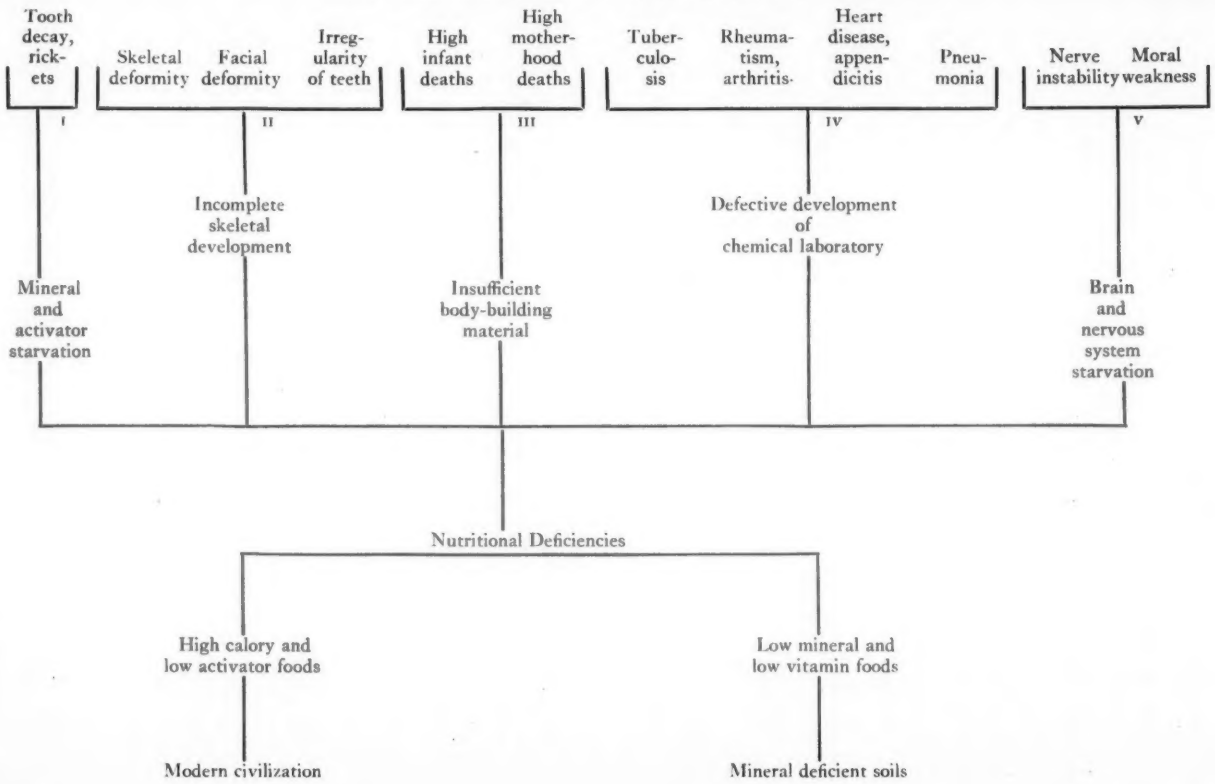
We have, therefore, two inherent forces at work in modern civilizations: one, a natural limitation of the soil and its progressive exhaustion, and man's habit of depending on his sense of hunger as his chief guide in both the kind and quantity of food that will be eaten. It has been abundantly demonstrated that poor soils produce poorer foods, not only in the minerals, which are deficient in the soil, but lower in activating substances, the creation of which is dependent on the chemical content of plants. These two forces combine to establish a nutritional deficiency, which produces varying effects in different periods of life according to the needs of the body. During the prenatal and postnatal growth periods, the needs of the body are very great, not only for minerals, but also for the special activating substances which are essential for the differentiations of tissues and for organ development. The

2. Price, W. A.: Some Means of Improving Human Life by Increasing the Vitamin Content of Milk and Its Product, Internat. Milk Dealers Ass'n Bull., Jan. 19, 1931.

TABLE 5.—PHYSICAL AND MORAL DEGENERATION WITH CIVILIZATION

Tooth	High	Heart

TABLE 5.—PHYSICAL AND MORAL DEGENERATION WITH CIVILIZATION



efficiency of the animal mechanism, physical and chemical, will be largely determined by the availability of the building material. While Nature will make the best of the available material, the ancestral order, as provided through inheritance, may have to be curtailed, not only for a single generation, but also continuously through many succeeding generations, thus introducing modifications which may become inheritance factors. Accordingly, progressive physical and, of necessity, moral degeneration ensues.

I have arranged these forces and their resultants in graphic form in Table 5 as my interpretation of some of the influences and their effects. For the two main roots of the tree, I would use, as indicated, modern civilization and mineral deficient soils. The former through its demands for high calory foods is very likely to choose those of low mineral and low activator content. The mineral deficient soils will inevitably produce foods of lower mineral and lower vitamin content. These provide a nutrition that is of necessity deficient in the elements essential for development and for the maintenance of maximum physical protection and efficiency. The influence of starvation for minerals and activator during the growth period will of necessity produce stresses in mineral metabolism during the period of most rapid growth of the long bones. This will appear as shown in Group I as rickets, and at any age when the daily mineral requirements are not provided by the nutrition, a stress will be established, with the result that Nature's safety device, namely, a capacity for borrowing from the stored minerals of the skeleton, will come into play. This produces a stress in body fluids, first in the blood and then in other serums, such that the saliva can no longer maintain an environment adequate to provide immunity to dental caries, which accordingly becomes active or even rampant in proportion to the stress. If these stresses are long continued and the body is not able to replenish the borrowed material and provide for adequate growth, the structure is stunted. The deficiency expresses itself at those points where growth would normally have been accomplished had building material been adequate. These effects will have their expression as in Group II, namely, as skeletal deformity, facial deformity and irregularities of the dental arches and the teeth. When the stresses for the body building material occur in embryonic and prenatal life, many handicaps develop for both the mother and child, which have expression as in Group III, namely, as abnormally high infant and motherhood mortality. These are conditions which exist strikingly in many in modern civilization in spite of the development of prenatal and postnatal care of mother and child. An important phase of these deficiencies would have its expression in the incomplete development of the chemical laboratories of the body with the result that defense against acute and chronic infections is lowered. These have their expression as shown in Group IV, apparently accounting in large part for the high toll of tuberculosis among the aborigines after they adopt modern foods, also the development of rheumatism and arthritis. Similarly, heart disease, appendicitis and rheumatism and a host of other affections develop which, in the light of newer knowledge, should largely be termed as symptoms rather than as unit diseases. When the deficiencies result in an incomplete development of the nervous system or fail to provide adequate nutriment for maintaining the brain and nervous mechanism, the

end-results will express themselves in many ways as included in Group V, nerve instability and moral weakness providing a rapid increase in institutional population.

It is of particular importance that we consider some of the available evidence as to the chemical factors that are involved in these processes. Since animal life cannot exist except as it obtains, directly and indirectly, products of plant life, we are concerned with advances in knowledge regarding the unit factors that the plant contributes. It is frequently said that all life can be traced directly to chlorophyll, which synthesizes the products of the air and plant juices through the medium of the radiant energy from the sun and thereby provides the nutrition of all animal life of the sea and land. Among the products so created are the precursors of the various groups of organic catalysts or enzymes, which enable the animal to build its special tissues of the elements that are provided through the plant tissues and the atmosphere. Some of these organic catalysts have their residence in the embryo or germ of the plant seed and in other plant tissues. The modern milling process apparently needs to eliminate these and much of the minerals from grains in order to prevent the growth of minute animal life that would feed on the ground cereals. Some of these activating substances are fat soluble, others are water soluble. These are stored in the organs of the animals of both land and sea and in special tissues of which they are an essential part. They apparently are transferred from animal to animal as one preys on another.

Among the precursors of the organic catalysts, certain products have recently been identified in the plant pigments. These include both fat soluble and water soluble groups. The carotenoids are fat soluble and accordingly are classed as lipochromes. The water soluble pigments, called flavines, are now found to be the precursors of the water soluble vitamin B^2. This group of pigments are the lyochromes. In the dairy products, the fat soluble factors are removed from whole milk with the butter fat. The water soluble activating substances go with the whey. These have now been concentrated by Kuhn and others[3] and have proved to be the most active stimulators of growth yet discovered. They have also been found to be capable of transition direct to chemical forms in which they act as organic catalysts and participate in intracellular metabolism.

Data have now been developed indicating that there are six provitamins A, three of which are different forms of carotene. Two molecules of vitamin A are formed in the animal body from one molecule of a carotene. Certain of the activating substances have been isolated and identified by their effects or chemical content or both. Doubtless, many other activators are still to be so identified. The rôle of these activators seems now clearly to be that of organic catalysts. When, for example, pigeons are not provided with an adequate quantity of vitamin B^1, the antineuritic factor, they develop symptoms of derangement of the nervous system. When the brain of such a pigeon is removed and placed in an atmosphere of oxygen, the quantity of oxygen being taken up is greatly enhanced when there is injected into the brain tissue a small quantity of vitamin B^1. Similarly, when such an injection is made into the brain of a live pigeon suffering from violent reactions in the nervous system, the symptoms disappear. This has been demonstrated by Gavri-

3. Kuhn, R.; Gyorgy, P., and Wagner-Jauregg, T.: Klin. Wchnschr., 12:124 (Aug. 12) 1933.

lescu and Peters.[4] Similarly, when vitamin B², the antipellagric factor, is insufficient in the nutrition, there is a very marked decrease in the rate of growth, and it has been shown by Kuhn that this vitamin behaves as a catalyst. Among the rôles that are played by these vitamins as organic catalysts, one is related to the formation or development of phosphorus in inorganic form apparently by an action of vitamin D on an organically combined phosphorus. My investigations[5] have shown that the inorganic phosphorus of the blood of normal persons tends readily to be adsorbed onto finely powdered bone and that in persons with disturbed bone growth and also in some pathologic states, this characteristic of the inorganic phosphorus of the blood is reduced. The quantity adsorbed may even be reduced to zero or may go into the opposite phase, in which inorganic phosphorus is taken from the powdered bone chips to the blood serum. Further, I have shown that this characteristic can be changed to normal by the administration of the fat soluble activators A and D, together with foods amply rich in minerals, the blood thus being apparently restored to normal in this regard. I have also shown that the saliva of persons who have an adequately high immunity to tooth decay is characterized by inorganic phosphorus factors which tend readily to be adsorbed on finely powdered bone. In the presence of active dental caries, a lesser amount is adsorbed, or the inorganic phosphorus may be increased in the saliva in the presence of powdered bone. I have also shown that this factor can readily be changed by the administration of the fat soluble activators and adequate mineral carrying foods as provided by Nature, with the result of controlling the dental caries. I have further shown that this abnormal characteristic of the saliva with regard to the behavior of inorganic phosphorus can be modified in the test tube by simply shaking the saliva with a foodstuff which is rich in the fat soluble activators. The clinical conditions of practically all patients who are suffering from rampant tooth decay can rapidly be changed to complete control of the caries process through this modification of the saliva even without mechanical or physical operation on the tooth, such as the placing of fillings. Similarly, dental caries can be completely prevented by this simple procedure. It is of interest that this is accomplished by restoring to the foods the chemical characteristics that are found to obtain in the foods of the primitive Eskimos and Indians and other races who had normally a very high immunity to tooth decay.

The application to the problems of the Eskimos and Indians of these new chemical seriologic methods for evaluating physical vitality levels has developed very instructive data. Some samples of blood were obtained from Eskimos who were living on their native diets. These were sent to my laboratory for chemical analysis for comparison with the blood of modern civilized persons. When tested by the foregoing procedure, these blood specimens showed a very high factor of safety. Similarly, 200 samples of saliva were collected and preserved and sent to my laboratory for chemical analysis and, on the basis of the type of nutrition, they showed

4. Gavrilescu, N., and Peters, R. A.: Function of Torulin. "In Vitro" Efficient of Antineuritic Vitamin Concentrates, Biochem. J., 30:2150, 1931.

5. Price, W. A.: Experimental Basis for New Theory of Dental Caries with Chemical Procedures for Determining Immunity and Susceptibility, D. Cosmos, 74:1139 (Dec.) 1932. Additional Light on Etiology and Nutritional Control of Dental Caries with Application to Each District Showing Immunity and Susceptibility, J.A.D.A., 22:1648 (Sept.) 1933.

a much lower factor of safety for the Eskimos and Indians who were living on "store grub" than for those living on the native foods. These data will be published in connection with similar studies among other racial groups.

As regards the origin of physical deformities, particularly those of the face and dental arches, we understand, in the light of this newer knowledge, why, in our previous efforts to change by mechanical force the configuration of the dental arches and facial features, we have been only partially successful and have often soon lost what we have gained. By the application of this newer knowledge, we are now able to do team work with Nature, and as teeth are moved and the arches enlarged, we may aid Nature in building the new hard structures and indeed stimulate her in her local growth processes. This reinforcement of Nature's effort is well illustrated in the changes that are produced in pulp chambers. In normal growth, there is a normal diminution in the size of the pulp tissues through the laying down of a normal dentin. In cases of nutritional stress, the pulps are abnormally large. This characteristic may be carried through life and be found as a deficiency in growth and at any time later when this tooth may be studied either during life, when it may be examined with roentgen rays or later by sectioning or roentgen rays. In the process of tooth decay, the dentin is demineralized often to the pulp chamber, while the organic matrix remains *in situ*. In such a tooth, the complete removal of the decalcified dentin would expose the pulp. If these patients are placed on a sufficiently nutritive diet, adequately reinforced with fat soluble activators, characteristic of the foods of the primitives, that were found to produce and maintain high immunity, there is established a remineralization of the dentin (not a revitalization) to such an extent that the leathery dentin may become stone hard and such that silver nitrate cannot penetrate it. This has been illustrated in previous reports.

Another factor that is particularly important is the fact that, in such a tooth as we have just described, wherein Nature has remineralized the decalcified dentin in contact with a normal saliva, the pulp tissue is also readily induced to lay down a new layer of normal dentin in such a position in the pulp chamber as to completely wall off the original decalcified area and thus restore the pulp to a relatively normal condition in its encasement as far as its immediate surrounding hard tissues are concerned. This has been accomplished in a large number of cases by selecting children in districts of the city where the stress of the industrial depression has greatly reduced the quantity of nutritious foods. These children were placed on one reinforced meal a day for six days a week, without changing directly the other meals. This is now being done in an equivalent way in the fourth group. The children are given the additional fat soluble activators that are provided from a high vitamin butter produced by cows eating rapidly growing green wheat, which is the best fodder found for accomplishing this. This butter oil is mixed with equal quantities of a specially high vitamin natural cod liver oil. The quantity given is a teaspoonful of this mixture at the time of eating the special meal, which consists of natural foods for providing minerals in liberal quantity and in suitable chemical form. Physical measurements and photographs are made of the children, together with roentgenograms of the teeth. It is of interest that the physical expressions of nutritional deficiency are apparently the

same in these children under this modern stress as were found among the primitive Eskimos and Indians.

The data that are being developed from my field investigations among Eskimos and Indians have not only supported my previous interpretations, but also provide a basis for enlarging the scope of preventive programs. They also throw light on the reason for the success of the nutritional program that I have been developing for the past fifteen years and have had in use in practical clinical cases for twelve years, with progressive increase in efficiency with the increase of knowledge.

The correctness of any theory which relates to the control of dental caries must stand the final test of not only preventing it from developing, but also checking it when it is even rampantly active. This phase of the problem has accordingly received diligent and continuous checking by the application of the principle, not only to average cases but also to the most extreme cases of dental caries that I have been able to find. Since referred cases are usually of the severe type, they have been given especially careful study with the recording of data.

In seventeen persons, many of them referred from other cities with more or less rampant dental caries, there were found 237 open cavities of apparently active caries. Most of these persons were in the teens and accordingly have twenty-eight permanent teeth. On this basis, seventeen persons would have 476 teeth. It will be noted accordingly, if one cavity is allowed per tooth, that approximately half of the total number of teeth were being attacked, or precisely 49.7 per cent of all the teeth had open cavities. This group includes only persons of whom I have been making critical examination every six to twelve months over a three year period. In practically all cases, roentgen-ray examinations were made in addition to clinical examinations of the teeth. While these persons have been on the reinforced nutritional program which I have directed during the winter and spring months of the past three years, only two new cavities have developed in the entire seventeen persons, or 0.4 per cent. It is not known just what length of time had occurred during which the cavities previously found had been developing except that all were receiving frequent and thorough dental service, most of them twice a year and many of them more frequently. It is accordingly probable that the cavities found had developed most of them in less than a year. That dental caries was not a new problem with these persons was clearly indicated by the very extensive and numerous dental restorations that had been made in these mouths. It is, therefore, apparent that there were 250 times as many cavities developed in the period preceding the starting of the nutritional program as in the three years following its adoption. If these data were reduced to a yearly basis, the comparison would show a much wider variation than even this large difference.

In a group of fifty persons, including the above-mentioned seventeen, who had been on this special nutritional program for from one to six years, most of them three years or more, there were only these two new cavities developed in the entire group. Allowing these persons to have an average of twenty-eight teeth per person, or a total of 1,400 teeth, this would represent an incidence of dental caries in a period of three years of 0.14 per cent. In this group of fifty, there are many instructive and striking cases.

For example, H. F., now aged 17, did not have a single cavity from October, 1932, to June, 1933, while taking

the capsules. From June, 1933, to May, 1934, while not taking the special vitamin capsules, she developed ten new cavities.

S. K., now aged 14, prior to 1931 had rampant tooth decay with pulps nearly exposed in all first permanent molars. The remaining deciduous teeth had been reduced to shells. She was on the special nutritional program from December, 1931, to June, 1932, during which time caries was completely arrested. She discontinued the capsules in June, 1932, and did not take any until October, 1933, during most of which time she was taking viosterol under a physician's prescription to prevent dental caries. She came in in October, 1933, with fourteen new cavities. She was immediately placed again on the special program, taking the special butter and cod liver oil capsules from October, 1933, to May, 1934. During this period, the dental caries was completely under control. During the time that she was not on the special program, there developed on many of the surfaces of the permanent teeth white patches of decalcifying enamel. Under the reinforced nutritional program, these largely disappeared, and those that did not regain their translucency turned dark.

In the group of seventeen above referred to, some should have special attention. J. H., now aged 20, sent in from another city, had thirty-eight open cavities in June, 1931. In addition to active caries, he had quite disturbing heart symptoms, which curtailed his activity, and he also had a marked sense of lassitude and weariness. He has been on the reinforced nutritional program during the fall, winter and spring since that time, except the summer of the first year. During this time, he has not developed a single new cavity. The density of all the teeth has progressively improved as evidenced by roentgen-ray records. His physical condition has been greatly improved so that he was able to carry on his college activities and heavy outside work in earning money to maintain his college expense. He is not conscious of a heart limitation, as he does not now get short of breath from ordinary exercise. When asked what the principal change was that he had noticed, he said that in addition to not feeling tired, he was more rested with six hours' sleep than formerly with ten hours'. A letter from him today states "At present, I am feeling in the best of condition."

A. W., now aged 24, had thirty-two new cavities in the two years previous to beginning the special nutritional reinforcement. She continued this regularly winter and spring months for three years and has not had a single new cavity since that time.

In a group of children whose mothers had the special nutritional reinforcement during gestation and lactation and who had been provided with the same dietary adjuncts during the winter and spring months of infancy and early childhood, not a single carious cavity has developed. A number of these children are now in public schools. Their physical development is distinctly above that of the average children of their age, as is also their efficiency in school work.

A considerable number of heart cases should have special mention. A typical one is that of N. F., now aged 52. She was referred by a physician in January, 1930 with a heart involvement so severe that she had to be carried up steps and could remain on her feet only a few minutes. The physician reported that her condition was very grave. After reinforcement of the diet, some infected teeth were extracted. She has been receiving reinforcement of her nutritional program regularly since January, 1930, to

this date (June, 1934). Her general health is so greatly improved that she goes about on street cars alone and without serious physical limitation. About three years after she started this reinforced nutritional program and after the removal of the infected teeth, her physician made the comment that, according to all the rules regarding hearts, she should have been dead two and a half years ago.

Another phase of these cases is directly related to the forces that are at work in the maintenance of immunity to dental caries, which indicate that the controlling factors are in large part resident in the saliva. I have previously presented data[5] indicating the presence in the saliva of chemical factors which vary directly with immunity and susceptibility to tooth decay. The rapidly increasing volume of data dealing with this phase is continually supporting previously made interpretations.

An important phase, therefore, of these studies has been involved in the collecting of samples of saliva and chemical analysis. This principle involves, as I have reported, the behavior of the inorganic phosphorus of the saliva and blood serum in the presence of finely powdered bone, which acts as an adsorbant. In cases with high immunity to dental caries, there is practically without exception a distinct reduction in the level of the inorganic phosphorus of the saliva when shaken with finely powdered bone. This change is expressed in percentage of indicated quantity found in the duplicate sample as tested without the presence of finely powdered bone. In normal persons, the percentage change, which appears to be the best way to express this factor, is from 20 to 30 per cent decrease. In persons with active dental caries, this reduction is practically always lessened and may be reduced even to zero. In cases of rampant tooth decay, this factor is found to be increased. Instead of inorganic phosphorus moving from saliva to powdered bone, it moves in the opposite direction. In practically every case wherein the activity of the dental caries is controlled, this factor changes to, or nearly to, normal. For eighty-two persons with active caries who had reinforcement of the nutritional program which was associated with complete control of dental caries, this phase of the saliva changed from an increase in the reading of inorganic phosphorus of plus 8.4, which is characteristic of a state of low immunity, to minus 11.2, which is characteristic of immunity to dental caries.

Clearly, the most exacting test for the control of dental caries will be provided by the most extreme cases, which are fortunately not available in large numbers in an average community.

I have, accordingly, been assisting groups of children in districts of the city where the industrial depression has critically reduced the food supply. From one to three of such groups have been under investigation each year for winter and spring periods during the last three years. I have previously reported some of these groups.[5]

Through the assistance of Harris R. C. Wilson, supervisor of dental health in the public schools, and his assistants, Dr. Pyle and Miss Herman, I have had sent to me twenty-four severe cases of dental caries. These were selected from a parochial school of 3,000 pupils. These children are of foreign parentage, mostly Polish. In each case, the following data have been recorded: roentgenographic examination of the teeth, a direct physical examination of the teeth, photographic record of the face when facial

deformities were involved and the chemical analysis of the saliva. Detailed daily menus were recorded by Miss Herman on forms provided by me. I also have a report of their grades at school before beginning of the treatment and after being on the treatment for one month. The nutritional program consisted of providing each pupil with special reinforcement as obtained from high vitamin butter and high vitamin natural cod liver oil in equal parts, furnished in bulk form instead of in capsules and taken from a teaspoon. Most of these pupils had not only very extensive destruction of the crowns of the molars and bicuspids, but also serious injury to the incisors above and below. The requirement for the parents before beginning the test was that the children must have one glass of milk for each of the three meals a day. A request was also made that as far as possible, entire grain breads be purchased instead of white flour breads. No requirement was made regarding this phase of the dietary.

This nutritional program was of necessity less effective than that usually provided the regular patients or special groups, such as the Broadway Mission and the West Side Community House groups, previously reported.

The average of the chemical analyses of the saliva for the group of twenty-four indicated a loss of immunity to dental caries amounting to a plus 0.8 per cent. After only six weeks of nutritional reinforcement, there occurred a change toward normal in the chemical analysis of the saliva from plus 0.8 to minus 5.7 per cent. Roentgenographic records revealed an increase, already perceptible to the eye, in the density of the tooth structure, with a building in of the pulp chambers beneath deeply carious areas. There was almost complete relief from pulpitis in the carious teeth. In one month, after beginning of the treatment, the average school grades increased 3.1 per cent. Only one pupil showed a lowered grade. A number of the teachers reported voluntarily to the school nurse that there was a marked improvement in the learning ability of the boys and girls. In one pupil, it was so marked that the teacher reported his condition to have changed from a very serious problem, since he apparently did not have the ability to concentrate mentally, to a marked increase in capacity for concentration and efficiency. This has been a frequent experience in the children of both my private groups and these special groups.

Approximately 200 specimens of saliva were collected from Eskimos and Indians in the various groups, including both those isolated and so living virtually on the native foods entirely and of other groups in contact with foods of modern civilization. It is accordingly important that these data be considered in connection with the direct applicability to the problems of modern civilization of lessons that are learned from these primitive people.

Since the examination of the Indians and their families was made at the time when they came out of the wilderness on their annual trek to the point of exchange of their wares, namely, the furs of the wild animals, for ammunition, rifles and such other products as they considered most important, they were of necessity examined at the one time in the year when they are in contact with the trading post and the imported foods. This sojourn lasted two weeks and was a time of merrymaking and feasting on the foods of the white man as found at the post. Even though they do not carry enough of this food back to their hunt-

ing grounds to constitute any important modification of the total year's nutrition, they were under the influence of the high calory and low mineral foods for this short period. Although this period of lowered immunity to dental caries might extend over two weeks, it would not, in that time, express itself in the development of caries, even though there would be expressed a lowered level of the immunity factors in the saliva, which would be of temporary existence. The data, accordingly, must be viewed in the light of these facts.

When the persons from whom specimens of saliva were obtained for chemical analysis were placed in two groups, those living on native foods and those on "store grub" or imported modern foods, consisting chiefly of white flour, sugar, sweetened goods, etc., the data indicated for forty-three persons receiving highly modernized diets a movement of the inorganic phosphorus from the powdered bone to the saliva amounting to a plus 9 per cent. For sixty-seven persons living for most of the year on native foods, although for a week or two preceding the obtaining of the samples they had been on modernized foods, the change of inorganic phosphorus in the presence of powdered bone showed a decrease of 2.7 per cent. This is in accordance with my data obtained for several other relatively primitive groups, as well as for immune persons of our modern civilization.

If, as seems indicated by these studies, physical form of an individual group or tribe is in large part an expression of nutrition, a study of skulls of persons or groups who have lived in an earlier period should record conditions which might be studied in relation to the known nutrition of the groups. With this in mind, I have been studying skulls in various collections to note such relationships. These studies will be reported in another communication. It is important to note here that a relationship between skull characteristics and nutrition is clearly evident.

The influence of heredity and environment on physical form has been the subject of extended investigations. A report to the Congressional Immigration Commission and at the sixty-first Congress, Dec. 5, 1910 on the "Changes in Bodily Form of Descendants of Immigrants" was prepared by Franz Boas, professor of anthropology, Columbia University. In this investigation, Dr. Boas compared factors as found in the American born and foreign born persons of the same races at various ages. His data indicated a marked tendency for the characteristic head forms for certain European races to change toward a common type. Thus, the cephalic index, "the width of the head expressed in per cent of the length of the head," which was for the Sicilians born in Sicily 78 per cent, increased for the Sicilians born in America to 80 per cent; while for the Hebrews born in Eastern Europe with a cephalic index of about 83 per cent, this factor in those born in America was reduced to 81 per cent.

In the light of the field studies herewith reported, it seems probable that these changes are largely the result of changes in nutrition. It is also suggested that racial stocks of any given place should be considered as an expression of that stock, with its given ancestry, while living in that particular food environment. Accordingly, neither the Hebrews of Eastern Europe or the Sicilians of the Isle of Sicily necessarily represent an exact racial type, but rather its expression in that particular environment.

We seem justified in anticipating that a new and higher type of physical devel-

opment may be accomplished which will be the product of an optimum nutritional reinforcement based upon the most perfectly balanced nutritional program that may ultimately be developed. Indeed, this offers a challenge for the motherhood of tomorrow and is far from being a visionary suggestion, since indeed it is already in progress. The time is not far distant when it will be a matter of keen humiliation for parents to have dental caries develop in their growing children, or to have irregular teeth or facial deformity mar their beauty and masticating efficiency.

SUMMARY

These data are interpreted to indicate that

1. Dental caries has not occurred among the Eskimo and Indian groups studied when they are living on a diet adequately reinforced with minerals and activators.

2. Nutritional deficiencies can produce in a single generation marked changes in physical development and skeletal form.

3. The principal factors in these changes are associated with a reduction of the minerals and activators in proportion to the calory or energy producing factors in the foods ingested.

4. Adequate diets appear to have been provided by a proper selection of the organs and tissues of either the animal life of the sea or the wild animal life of the land, and apparently both are as effective as more elaborate menus.

5. Lowered resistance to disease has been found to be related to disturbed physical development during infancy and childhood due to deficient nutrition.

6. The pigments of plants are found to be essential for life in animals. They can now be traced from the plants to storage depots in organs of animals and apparently are the precursors of many activators including vitamins and organic catalysts or enzymes, which control intracellular metabolism.

7. A basis has been suggested to account for progressive individual and group degeneration.

8. The application of these new principles in clinical practice has been found to be competent to prevent dental caries or control it when it is active.

9. The application of these data indicates a basis for individual and racial betterment.

8926 Euclid Avenue.

NEOPLASTIC JAW DISEASES: CARCINOMA OF MAXILLA: REPORT OF CASE*

By CONRAD C. GILKISON, D.D.S., Cleveland, Ohio

A WOMAN, aged 67, who had been receiving antisyphilitic treatment for a number of years, had a nodular infiltration on the right side of the face, not far from the corner of the mouth. The lesion extended down into the subcutaneous tissue. The surface was dull red and nodular. One nodule was raised and softer than the others. An ulcerated, somewhat fungoid lesion, covered with a yellowish gray exudate, involved the alveolar margin of the upper jaw anteriorly. The clinical impression was that the nodule

*Presented with case reports of neoplastic disease before the Western Reserve Alumni Association, Cleveland, Ohio, June 9, 1932.

on the cheek was a granulomatous lesion, probably gumma, and that the involvement of the jaw was due to malignancy. The lesion in the jaw had developed rather rapidly over a period of about five months. The roentgenogram showed diffuse density of the right antrum with evidence of destruction of the upper and lower medial walls.

"Most of the responsibility for these

Fig. 1.—Ulceration at gingival border and nodular lesion on cheek.

Fig. 2.—Occlusal dental films, showing bone destruction over right hard palate.

patients rests with the general practitioners of dentistry and medicine. They are the first to be consulted regarding any aberration or pain in the oral cavity.

"Although there are some exceptions, most common malignancies of the jaw can be diagnosed very readily by biopsy, which is a simpler operation than the extraction of a tooth. Every lesion of the mouth which fails to yield promptly to treatment should have a piece of tissue removed for microscopic examination."[1] A biopsy was not made, because the clinical and roentgenographic evidence was overwhelmingly in favor of a malignant growth, and its extension precluded any benefit from operation. Although no pathologic report is available in this case, the patient's age, the rapidity and extension of the growth and its clinical appearance make a diagnosis of malignancy quite justifiable.

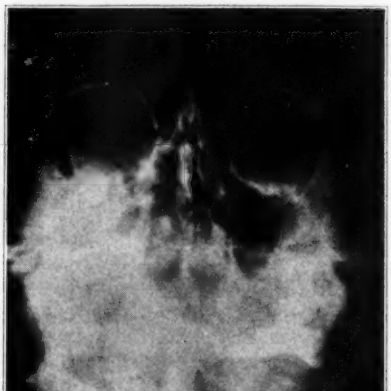


Fig. 3.—Anterior-posterior plate, showing diffuse density of right antrum with evidence of destruction of upper wall and lower medial wall.

"Any swelling of the cheek or glands, any intra-oral tumor and pain over the posterior maxillary ridge, especially if present in elderly persons, should cause suspicion of malignancy. Pain over the second division of the fifth cranial nerve may have many causes. Each of these should have thorough investigation before the teeth are extracted.

1. Gilkison, C. C.: Carcinoma of Jaws, Internat. J. Orthodontia, 19:1153 (Nov.) 1933.

"The most outstanding advance in treatment of carcinoma has come through the early recognition of the disease. With care and intelligence early diagnosis of cancer is possible, and is one of the greatest possible services that can be rendered to the patient with malignant disease."[1]

"It is of great importance to the patient that the proper diagnosis be made before any extractions, operations or curettement are done."[2] This is an edentulous case; teeth do not have to be considered. In most cases of pain in this area, the extraction of teeth would have first consideration.

2. Gilkison, C. C.: Adenocarcinoma of Hard Palate, Internat. J. Orthodontia, 20:145 (Feb.) 1934.

NECESSITY FOR ENDOCRINE TREATMENT IN SUCCESSFUL PROSTHESIS*

By MELVIN E. PAGE, D.D.S., Muskegon, Mich.

A DEFINITION of the term "successful prosthesis" may well be considered. One definition might be "one which functions well and looks good enough to satisfy the patient, and for which the dentist receives his fee."

Another and broader definition is: "a prosthetic restoration which functions well, looks well and is comfortable not only until the fee is paid, but also for many years."

To obtain the latter result, the foundations of the restoration must remain stable; for without this stability of foundation, the functioning of the dentures is, in great measure, lost. They no longer have the ability to maintain balance under stress. Even the centric relation becomes changed, resultant malocclusion in turn increasing the rate of change in the process of the underlying foundations.

That this instability of process under dentures is anticipated by the profession is evidenced by the common use of non-anatomic posterior teeth, by means of which the ill-effects of the changed anteroposterior relationship are lessened, but at the expense of efficiency, esthetic values and loss of vertical distance.

It is to be expected that, in the majority of denture patients, the alveolar ridges will undergo more or less absorption, for the systemic conditions that brought about the loss of the natural teeth, unless corrected, will continue to lessen the stability of the alveolar process.

When we as prosthetists do have a case in which the ridges are stable, our reputations, as far as that patient is concerned, are made. Even when nothing else about the case is as it should be, the patient adjusts himself to the dentures to a remarkable degree. On such occasional stable cases depends much of the practice of the charlatan. If none of their dentures could be worn, their denture clientele would soon diminish.

It is a notable fact that the chief factor in the more or less occasional success of the charlatan is the use of cheap teeth, teeth in which the occlusal form was but faintly suggested; while the conscientious dentist used the best anatomic teeth to be procured, thereby obtaining the ut-

*Read before the Section on Full Dentures at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

most efficiency of the dentures if the process remained stable, but letting himself in for great difficulties if it did not.

I believe that the solution lies not in the general use of nonanatomic teeth, but in the attention paid to the correction of the systemic conditions which cause this shrinkage of denture foundations. Because we have learned to expect this shrinkage of process under dentures, the prognosis has been so bad for remaining teeth that it has been customary in a great many cases to sacrifice the lower six anterior teeth rather than construct a lingual bar partial denture, thus lessening the trauma due to unequal absorption.

Stable ridges alter the design of restorative appliances. It becomes less necessary to depend almost entirely on the remaining teeth for support; a situation which greatly increases the life expectancy of these teeth, and because their life expectancy is thus increased, the possibility of saving the few remaining teeth becomes greater.

In the large majority of patients, stability of process is negligible, but, in some cases, rather rare it is true, the process remains stable for long periods of time.

That this accidental stability occurs is known to every denture maker. A better understanding of the factors in these cases and in those in which the process is very unstable will show how this last condition can be rectified.

The problem before us is to make it possible to produce this stable condition of process in patients for whom, under prevailing practice, the dentures would remain stable but a very short time.

Practically all the literature on the conservation of alveolar process deals with the subject from the standpoint of trauma; that is, the mechanical perfection of the dentures as regards fit, balance and tissue tolerance. Still another means of helping to conserve the process which has not been so well covered is the systemic condition of the patient, with its correction.

Dentistry started out as a craft, concerned with the mechanical repair and replacement of missing teeth, and gradually grew to include the medical treatment of oral lesions, but in so doing found its field broadening, as one part of the body cannot be considered an entity separate from the rest of the body. In the mouth is found both the causes and the results of disease elsewhere. The trend is clear. The dentist must have as much medical education as the rhinologist, the pediatrician, the gynecologist or any other specialist of medicine. Likewise, the prosthodontist must consider not only the mechanical problems of denture construction, but also the effect of wearing the prosthesis upon the patient and the effect of the patient upon the prosthesis.

We know that alveolar process is similar to bone and like bone responds to the same laws of nourishment. We do mark this difference: the process may be lost under certain systemic conditions that apparently affect the other body tissues but slightly.

We also know that teeth and bone respond to the same systemic conditions, the difference being only in the degree to which they respond. We will not go far astray in assuming that, in general, the alveolar process is subject to the same laws as are the other bony tissues, including the teeth.

We find that teeth and process are subject to the same laws of nourishment and to similar laws of mechanics in that both are healthy under some systemic conditions and unhealthy under other systemic conditions, are capable of withstanding proper stresses and suffer from abnormal or traumatic stress.

Systemic treatment is advisable in nearly all denture cases. The patient us-

ually loses his teeth because of a disturbed mineral metabolism and will likewise lose his ridges if this condition is not rectified.

I find that immunity to caries in patients 18 years of age or over can be determined by the analysis of the blood for calcium and phosphorus. To be immune, the product of the usable serum calcium and phosphorus, in milligrams per hundred cubic centimeters of blood, must be 30 or above, and the calcium and phosphorus must be in proper proportion or balance. Price, Crile and others have also found that, when this condition exists, fractures of the long bones unite and heal rapidly and that when a low content of calcium and phosphorus or an imbalance is found in the blood, fractures are slow to heal, even to the point where union is impossible. It has been found also that the long bones will shrink in size in a person in whom the blood mineral content persists in being low or in imbalance for long periods of time, such as in the aged. A shortening of stature of as much as 5 inches has been noted.

The index of immunity to absorption is indicated by the usable calcium-phosphorus level. The usable calcium and phosphorus is that portion of these minerals, as determined from the blood analysis, which can unite in the proportion of $2\frac{1}{2}$ of calcium to one of phosphorus or in the proportions of 10 to 4. Either one of these minerals in excess of these proportions is free and may be deposited as such in abnormal places, producing disease.

Free calcium is responsible for kidney stones and for calcular deposits on teeth and dentures. Free phosphorus is often associated with the presence of pulp stones, inflammatory conditions, such as pyorrhea and arthritis, chronic appendicitis and colitis.

Immediately after extraction, there can be no real stability of the alveolar process. Spicules and rough areas must be absorbed and smoothed over and a cortical layer must be built. During this period, the patient should have immediate dentures built in such a way that minimum pressure is required to masticate food and constructed of some material easily trimmed, adjusted and relined.

During this time, systemic treatment proceeds, that the patient may have the desired cortical layer formed as soon as possible. To do so, instruction as to diet should be given.

The ordinary American adult diet in the northern states contains a sufficiency of calcium and phosphorus, but if, on inquiry, this is not found to be true of the individual patient, the diet is rectified. A common deficiency in the northern states is of vitamin D. City dwellers do not as a rule venture outdoors any more than is necessary in the winter months, which are seven or eight of the twelve, and when they do, it is mostly in glass enclosed cars. Such a mode of living creates a general deficiency in the sun-given vitamin D, which controls the assimilation and level of one of the important bone and tooth minerals, calcium.

In some parts of the country, there is a real deficiency of calcium in the soil. A deficiency of calcium in locally grown foods must be supplemented by the use of foods having the desired amount of calcium.

Other vitamins have been found to play a part in bone building and maintenance. These are vitamins A and C, which can readily be supplied in the modern diet with almost the ease and facility in the north as in the south, owing to the marvels of modern transportation.

Most cases will show a sufficiently high calcium content, as it does not usually

vary to the degree that the phosphorus does. A range of from 9 to 11 mg. is usual. The minimum requirement is 8.7 mg. If it is desired to raise the calcium content of the blood, feeding of calcium in the form of dicalcium phosphate, calcium lactate, calcium gluconate or milk with the addition of vitamin D will give the desired results.

Usually, the addition of cod liver oil to the diet will increase the calcium content of the blood to the desired point, for lack of sufficient calcium in the food is not so common as has been thought.

The phosphorus level should be exactly 40 per cent of the calcium level. When the phosphorus level is more than or less than 40 per cent of the calcium level, an imbalance exists. Such an imbalance cannot be corrected by feeding phosphorus or omitting it from the diet, except possibly temporarily. The imbalance of phosphorus is caused by endocrine dysfunction, and endocrine treatment must be used to restore the balance.

When the phosphorus of the blood does not have the correct proportion of 40 per cent of the amount of the calcium, there is direct evidence that the metabolism is abnormal. Restoring the metabolism to normal will correct the disproportion.

There are five endocrine glands involved in calcium-phosphorus metabolism, the thyroid, the parathyroids, the gonads, the hypophysis and the thymus.

Of the endocrine glands involved in calcium-phosphorus metabolism, the thyroid apparently is the most important, as it more or less determines the functioning of the others. When there is an imbalance of calcium and phosphorus with an abnormal metabolism, the treatment lies with the thyroid. It is perfectly possible that the dysfunction of the thyroid is due to its effort to counterbalance a dysfunction of some other endocrine gland, but as far as my experience goes, treatment of the thyroid seems to do the work, except in cases of secondary hypothyroidism; i.e., lessened function of the thyroid due primarily to lessened secretion of one of the hormones of the anterior lobe of the pituitary. These cases are relatively few, and the calcium-phosphorus level of these also can be built up to the immunity level by suitable treatment.

In that section of the United States known as the Great Lakes basin, dysfunction of the thyroid is very prevalent. This condition may evidence itself either in hyperfunction or hypofunction. The former is easily recognized, and nearly all of the literature on thyroid dysfunction deals with this phase. A condition not so generally recognized is hypofunction of the thyroid. In Michigan, where I have been investigating thyroid dysfunction in its relation to teeth and process, it has been difficult to find patients not affected in this manner. The percentage of hypothyroidism is very high. I believe, from what opportunity I have had to examine patients from other parts of the country, that this condition is not confined to the states bordering the Great Lakes, but exists to a greater or less degree throughout the country.

The general run of patients in my practice show endocrine dysfunction to about 94 per cent, of the total of which about 4.5 per cent show hyperfunction. This has been determined by symptomatic diagnosis, by calcium-phosphorus balance and by metabolic registration.

Dysfunction of thyroids is supposed to be due to lack of iodine in the food. Attempts to rectify this condition have been made by adding sodium iodide to the drinking water in some large cities and by the use of iodized salt. Goiter in these cities is much less prevalent now than formerly, but I believe the organic form

of iodine rather than the inorganic would be more easily assimilated.

Again, we are not so sure that all the blame can be laid to the absence of iodine. There is definite evidence that the lack of minute quantities of manganese in the food tends to lower the metabolism. Also, some forms of anemia affect the metabolism, the condition being much improved by the addition of iron and copper to the diet.

The minerals in the soil are nearly all more or less readily soluble, and in the course of countless centuries, a great deal of those most readily soluble must have been washed from the soil or taken up by plants and not replaced.

Hypothyroidism affects the phosphorus level of the blood. The phosphorus will not have the correct ratio to the calcium, but will be either less or more than 40 per cent the amount of the calcium.

Hypofunction of the thyroid is diagnosed by various clinical symptoms, some of which are: increased weight in the lower part of the body and legs in females; thickening of the tongue, dryness of the skin and brittleness of the hair and nails, loss of hair in the male; mental sluggishness, quick flare-ups of temper, anemia and chronic constipation, sometimes changing to chronic diarrhea. Rectal crypts and hemorrhoids are common. The determination of the basal metabolic rate is subject to much error by the present means of determination of oxygen consumption, the error usually being on the side of increased metabolism, and therefore less useful in the determination of hypofunction.

The treatment of hypothyroidism is the administration of thyroid extract to augment the supply which the thyroid produces or to administer those minerals the lack of which caused the dysfunction.

The administration of thyroid, except in experienced hands, is dangerous. No more should be given than to supply the deficiency existing in the person treated. Administration of a greater quantity tends to decrease the functioning of the gland so that the condition is worse than before. A safer and surer method is to administer kelp in daily doses to supply as a food those minerals which will give the gland an opportunity to recover its function normally. This recovery will take place ordinarily in a very short time in the vast majority of patients. Occasionally, a patient is met in whom hypofunction is more or less hereditary. They usually give a family history of having lived for several generations inland. Either early loss of teeth or arthritis characterizes the family history.

In such cases, thyroid not to exceed one-fourth grain of the enteric-coated product is administered daily, together with kelp. Frequent calcium-phosphorus checks should be used to determine whether the dosage should be decreased.

Sea food other than kelp furnishes the desired minerals and, if a supply is readily obtainable, it is desirable as a frequent portion of the diet. Kelp is a godsend to those living where animal sea food is not readily procurable. A small quantity furnishes more minerals than a large quantity of animal sea food and at a fraction of the cost.

I believe that the ability of cod liver oil to raise the phosphorus level is due to the mineral content of the oil rather than the presence of vitamin D.

We find a marked difference in the ability of cod liver oil and viosterol to raise the phosphorus level. Likewise, the general level of calcium and phosphorus of those hospitalized patients that I have examined does not run markedly different in June and July from what it does in January and February. Yet, in our locality, we have an abundance of sun-

shine in the summer and very much less in the winter.

Hyperthyroidism is recognized clinically by an increase in weight in the upper part of the body in females, rapid pulse, palpitation, increase in appetite, nervousness and thinness, irritability, fine tremor of the hands, loss of weight and a high basal metabolic rate, for determination of which the present method is more reliable than for hypofunctioning thyroids.

The treatment for hyperfunctioning thyroids is surgical, by removal of infection; or the administration of small doses of organic iodine, such as in kelp, if the hyperfunction is susceptible to treatment, as in the incipient stage. The same condition—lack of minerals—may be factors in either condition.

Cod liver oil in the winter months to furnish vitamin D for calcium fixation, with kelp the year around to establish and keep the phosphorus level in proportion, will do much to keep the patient in good health, not only dentally but systemically, and will raise the usable calcium-phosphorus product above 30; a condition favorable for the maintenance of alveolar process.

The case showing the highest level of phosphorus that I have observed had the most serious disease. This reading was: calcium 11 x P 8.4, a phosphorus proportion to a calcium of 76 per cent. The reading was taken shortly before the patient spent six weeks in bed with arthritis in the lumbar region and sciatica. He had a blood pressure of 95 and a metabolism of −9. He was treated with a daily dose of one-fourth grain of thyroid extract, whereupon his arthritis disappeared. His tests at later dates showed: 12 x 4 and 10 x 3.5. At present, the figures are 10 x 3.8. The blood pressure has risen to 118, where it is fairly stable.

A number of cases of arthritis have been cleared up by balancing the calcium and phosphorus of the blood serum. The point to be brought out is that, in all of these cases, the phosphorus was in excess of 40 per cent of the amount of calcium.

Another case more nearly pertains to the subject of alveolar bone:

A woman, aged 45, had had several sets of dentures in three years. A blood test was obtained to determine whether the cause of the excessive absorption could be ascertained. The calcium-phosphorus product was found to be 18. The diet was carefully regulated and another test made after four weeks. The product at that time was even lower, only 16. A metabolism test was made and the rate found low. Thyroid extract was given and the third test after a short interval was 25. The treatment was continued and later dentures were made.

In the three succeeding years, there was no perceptible shrinkage of the process. A good cortical layer had developed and the patient had attained comfort in wearing dentures.

After the patient's usable serum calcium and phosphorus product has reached 30 or more and sufficient time has elapsed for the cortical layer of the process to form, it is perfectly safe to make the permanent dentures, and without fear of failure, if the mechanical causes of absorption are avoided in their construction.

The foregoing statements in regard to absorption of alveolar process and means toward overcoming this undesirable condition are not theoretical. The ideal of prevention is just as important in prosthetsis as in other branches of dentistry or medicine, and although its principles are applied a little late in the case of the denture patient, his previous experiences make him very receptive.

A few case histories, with the corre-

sponding tests for serum calcium and phophorus, are illustrative:

Total	8.2×3.8=31; P=46.3%
Usable	8.2×3.3=27; P=40 %

This test was of an elderly man who gave a history of having several sets of teeth, none of which were comfortable. His dentist had made repeated efforts to make him comfortable, without success. The story told by the blood test furnished the reason. Both calcium and phosphorus were low, and the proportion of phosphorus to calcium was high. Cod liver oil and kelp were taken daily and new metal based dentures were made. The patient is now comfortable and, best of all, grateful.

Other patients appeared, showing the following figures:

Total	11.2×2.4=27 ; P=21%
Usable	6 ×2.4=14.4; P=40%
Total	9.5×3 =28 ; P=31%
Usable	7.5×3 =22.5; P=40%
Total	10.5×3.1=32 ; P=30%
Usable	7.75×3.1=24 ; P=40%
Total	8.5×4.2=36 ; P=50%
Usable	8.5×3.4=29 ; P=40%

These all responded to treatment, so that, in a space of two or three months, it became safe to construct permanent dentures for them with assurance of satisfaction.

Most of my records are of patients that still had their teeth, some of them having rapidly progressing caries. In a short space of time, they became immune to caries, on the daily administration of small amounts of kelp.

May 26	
Total	8.5×3.5=31 ; P=41%
Usable	8.5×3.4=29 ; P=40%
Oct. 6	
	9.5×3.8=36 ; P=40%
May 25	
	9 ×4 =36 ; P=44%
July 27	
	10 ×4 =40 ; P=40%
July 7	
	10 ×3.6=36 ; P=36%
Aug. 8	
	10 ×4 =40 ; P=40%

Another case showed a reading in March of

8 ×3.5=28 ; P=44%

This patient, who had pyorrhea for ten years and had caries also, was given dicalcium phosphate and cod liver oil. In April, a test showed

10 ×3.5=35 ; P=35%

She was then given kelp and in May, a test showed

11 ×3.9=43 ; P=36%

Thus, a condition of immunity to caries and pyorrhea developed in two months. Continued use of kelp throughout the summer resulted in

9 ×3.8=36 ; P=42%

This was not quite perfect, but improving.

Owing to the wide variation in the readings of successive metabolism tests taken on the same case, no significance has been attached to the incidence of caries and density of bone, and alveolar absorption and metabolic dysfunction. The key to this relationship has been discovered.

If the assumption that metabolism controls the incidence of dental caries is correct, an accurate determination of the basal metabolic rate should check with immunity or susceptibility to caries.

The prevailing method used to establish the basal metabolic rate is to measure the oxygen consumption for a given

length of time. To do so, a quite complicated piece of apparatus is used, and from the amount of oxygen consumed over a given period of time and by means of tables of average body surfaces for a person of given height and weight, modified by the room temperature, the energy consumed is calculated.

The patient must be prepared for the test. The method commonly used is to hospitalize the patient for the night preceding the test, which is made the following morning on an empty stomach. Not so much as a glass of water is allowed, as this would consume energy and influence the results.

A nose clamp is applied and the patient breathes through his mouth, through a mask which is connected by means of a tube to the apparatus. The patient should not be nervous or be excited in any way by the procedure as this would raise the metabolic rate considerably. The very term basal is descriptive. To be accurate, the test should be made under ideal conditions of a uniform nature and at about 3 o'clock in the morning, while the patient is having a dreamless sleep, as the life processes are at their lowest ebb at this time and under these conditions.

As it is apparent that it is impossible to obtain such conditions, the results of such tests must indicate a metabolic rate greater than the actual basal metabolic rate.

That such is the case is well known. It has been generally considered that the first test of a patient is useless, and only by repeated tests can a fair determination be made. Even these may vary over quite a range. The practical effect of this method of determining the metabolic rate is to establish an average; but as the average person has caries of the teeth, it is not of much use to us in determining caries susceptibility. It is of great use in determining the presence of hyperthyroidism.

Theoretically, there should be another method of measuring metabolism by measuring the effect of a continued metabolic disorder, if such effect is quite common to a large class of persons and is proportional to it in degree. Such an effect exists.

It has long been noted that women showing hypothyroidism have a tendency to acquire weight from the waist down, while women showing hyperthyroidism tend to have thin lower extremities, but well developed upper portions of their bodies.

By means of a system of comparative measurements of the forearm and leg, this effect of alteration of metabolism can be demonstrated in cases of slight metabolic dysfunction and in young women in whom this effect would not be evident to the eye.

The method, a simple one, can be applied in a very few minutes by the dentist himself or his assistant with no more complicated equipment than a tape-measure and pencil and paper.

This test is based upon the symmetry of the person in whom there is no endocrine derangement and upon the asymmetry which develops when there is an endocrine derangement. It is very accurate for the untreated patient or for the treated patient when sufficient time has elapsed to change the proportionate dimensions of the body members measured.

It is as follows: The length of the forearm is measured from the tip of the elbow to the wrist joint and marks placed on the arm with a soft lead pencil at intervals of one-fourth this distance, beginning with the wrist. The leg is measured, from the knee cap to the ankle and marks placed on the stocking with tailor's chalk at points one-fourth

this distance apart, beginning with the ankle.

The circumference of the arm and of the leg at these points is measured with a tape-measure held lightly in contact with the skin and stocking. This gives the circumferential measurements at five equidistant points on the arm and five on the leg.

Now, the leg measurements are divided by the corresponding arm measurements and the five results secured are added and divided by five to obtain the average. This gives the comparative size of the leg and the arm.

In the normal healthy female, there is a relatively constant proportion of the leg to the arm and, in such a person, the proportional measurement secured will be from 1.420 to 1.430, irrespective of size or shape.

When there is an endocrine hypofunction, the measurements will give a result showing the leg to be larger in proportion to the arm than the normal. When there is an endocrine hyperfunction, the measurements will show a leg smaller in proportion to the arm than in the normal person. The range in my experience will be 1.300 to 1.400 for hyperfunctioning endocrines and from 1.430 to 1.650 or more for hypofunctioning endocrines. The farther away from the normal the measurement is, the greater the dysfunction.

This method of measuring the effect of continued endocrine dysfunction checks very accurately with the patient's susceptibility or immunity to caries. The calcium-phosphorus balance also checks fairly accurately with the plotted position of the measurement.

Discrepancies are due to the differences in rate of change of the calcium-phosphorus level of the blood, the density of hard tissue and the relative proportions of the body members; the blood picture changing first; then, the density of the hard tissues, and last, the body proportions.

This chart shows that patients may be divided into three classes according to their response to endocrine dysfunction. The first and larger class are those whose phosphorus level is lowered coincidently with endocrine dysfunction. In these persons, about 80 per cent of the total, the number of carious areas per year can be accurately estimated by the degree of disproportion shown. Also, the percentage of phosphorus to calcium can be very accurately estimated.

The second class are those whose response to endocrine dysfunction is an increase in the percentage of phosphorus to calcium. The increase here is also in proportion to the dysfunction. Such persons have almost always perfect teeth, but are particularly susceptible to arthritis, the development of pulpstones and pyorrhea.

The third class, the variables, whose phosphorus level swings like a pendulum, part of the time being in excess of normal and part of the time being less than normal, have caries, but do not average as many cavities as those in the first class. They are subject to intermittent flare-ups of arthritis.

When we find a patient with normal proportional measurements, we find the phosphorus level almost exactly 40 per cent of that of the calcium, and we find an immunity to decay.

Finally, we find that, by endocrine treatment, we establish immunity to caries. The phosphorus becomes 40 per cent of the amount of calcium in the blood serum and the disproportion of the body members changes to a correct proportion.

All of these facts apply equally to process; therefore, the necessity of endocrine treatment for successful prosthesis.

SUMMARY

Alveolar absorption is due to three conditions, the chief of which is the systemic. The systemic condition as regards bone is determined by clinical evidence, by the Benedict test for calcium and phosphorus in the blood serum, and by the metabolic rate. Under the ideal condition, the calcium and phosphorus (usable product) should be 30 or over, and the proportion of phosphorus to calcium 40 per cent. These proportions are obtained by dietary measures of which the most important in our latitude is the addition of vitamin D and organic minerals, correction of dysfunction of the endocrine system and removal of infection.

FULMINATING OSTEOMYELITIS OF THE MANDIBLE WITH PATHOLOGIC FRACTURE*

By HARRY J. FIELD, D.D.S., and ALFRED A. ACKERMAN, A.B., B.Sc., D.D.S., Newark, N. J.

OSTEOMYELITIS of the mandible is perhaps one of the most serious complications which may follow the simple extraction of teeth. Fortunately, the incidence of this infection is comparatively narrow. It is important, nevertheless, that those men who concern themselves with the responsibility of routine exodontia be well informed regarding the etiology and pathology of this disease.

We do not intend in this short paper to present a comprehensive review of a subject which has so many ramifications. Rather, we plan to discuss a series of roentgenograms that clearly reveal the various stages in the progress of the disease. A careful study of this series of films will, in our opinion, be of considerable aid in arriving at a clear understanding of the condition.

The previous history of this case as reported to us by the dentist referring the case may be briefly stated as follows: A railroad man, aged 54, decided to have all his remaining upper and lower teeth extracted. The general condition of the teeth and supporting structures prior to extraction may be described as unhygienic. An extensive alveolar absorption was present about the necks of all the teeth, accompanied by the presence of heavy calcareous deposits and much soft food débris about the gingival margins.

The mouth was divided into sections and four or five teeth were removed at each sitting, under local infiltration anesthesia. In three sittings, all the upper teeth were removed. Healing was rapid and uneventful. When the upper jaw was healed, the five posterior teeth on the lower left side were extracted, under conduction anesthesia. There was no subjective or objective evidence of an acute pathologic condition at the time of the extractions, which were of themselves uncomplicated. None of the teeth were fractured and no curettage of any kind was performed. The patient did not return to the office for postoperative treatment for nine days. When he did return, there was marked swelling on the left side

*Presented at a clinic at the Midwinter Meeting of the New Jersey State Dental Society, January 19, 1935.

of the mandible, and he complained of severe pain.

It was at this time that the case came under our observation. Figure 1 is a photograph taken on that day. There was marked induration of the submaxillary tissues and a gleaming spot of fluctuation to the left of the chin. The temperature was 101 F. The lateral jaw plate was of little interest. All the sockets were clear and the structure of the bone seemed normal. Close study revealed one small spot of bone beneath the bicuspids which was not normal.

Fig. 1.—Acute swelling, with point of external fluctuation.

The immediate need at this time was the establishment of adequate drainage. For this purpose, the patient was placed under nitrous oxide-oxygen anesthesia and an ample incision was made through the fluctuating skin. The underlying tissues were bluntly dissected down to the lower border of the mandible and a large quantity of thick, creamy pus was evacuated. A drain was inserted and the wound bandaged.

While the acute symptoms quickly subsided, the pus continued to flow liberally and the entire clinical picture pointed toward the rapid development of an acute osteomyelitis. One week after the original film was made, a second lateral view gave the typical appearance of an acute osteomyelitic process. The invasion of the entire side of the mandible, coupled

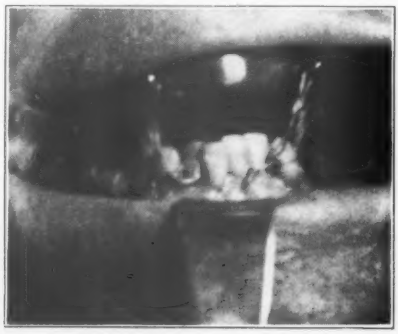


Fig. 2.—Appliance in position. The lower teeth are wired to loops in the appliance.

Fig. 3.—Calcification of new tissue completed.

with the characteristic moth-eaten appearance of the bone, was outstanding. In this stage of the infection, the only indicated procedure is the maintenance of free and adequate drainage. Curettage of any kind is contraindicated.

Two weeks later, the third lateral plate was taken. Along with localization of the process to the region of the bicuspids and first molar, a definite pathologic fracture of the bone had developed. A large section of the inferior border had become detached from the main body of the bone. Immobilization of the jaws was imperative at this stage of the infection. Since there were no upper teeth, a mechanical appliance had to be constructed which would simultaneously perform two important functions: primarily, produce complete immobility of the lower jaw, and secondarily, prevent the fractured posterior fragment from being pulled upward by the powerful temporalis and masseter muscles, as such a movement upward would result in marked deformity of the outline of the face when healing ensued. By means of wiring the lower teeth to loops in the appliance, our first objective was attained (Fig. 3). By a projection extending from the posterior section of the appliance and resting on the lower mucous membrane in the second and third molar region, our second objective was attained.

One week after the introduction of the appliance, another lateral roentgenogram was taken. The large sequestrum at the lower border had definitely moved downward and Nature was attempting to exfoliate this dead mass of bone. At this stage, it is necessary to assist the process of exfoliation. For this purpose, the external opening was enlarged, and the underlying tissues again bluntly dissected until the sequestrum was seen. The latter was seized with a pair of hemostats and gently removed (Fig. 2).

After removal of the sequestrum, the infection rapidly subsided and, in a remarkably short time, the flow of pus stopped entirely. One month later, the appliance was removed and a new roentgenogram taken (Fig. 3). Already, the early signs of calcification could be seen in the newly deposited osteoid tissue. Four months later, the new bone was almost completely calcified, the bone being restored to its original contour with absolutely no evidence of deformity.

The remaining lower teeth were later removed under nitrous oxide-oxygen anesthesia. Shortly thereafter, the patient returned to his dentist, who constructed a set of dentures for him.

CONCLUSION

From a surgical point of view, successful treatment of acute osteomyelitis of the mandible is dependent on sound, conservative judgment coupled with the ability to anticipate the developmental phases of the disease and prepare for them in advance, thereby minimizing their destructive force.

130 Market Street.

ARTIFICIAL DENTURE PROBLEM, PAST AND PRESENT; NEED OF RESEARCH IN THE IMMEDIATE FUTURE*

By W. J. PRYOR, D.D.S., Cleveland, Ohio

DURING the eighteenth century, several outstanding achievements were recorded in the evolution of the science of artificial denture construction.

Gariot, in 1805, originated the plaster articulator, a convenience in setting teeth at the bench. A few years later, mineral or porcelain teeth were introduced into this country from France by Plantou. Improved by Sam Stockton and his nephew, Sam S. White, they soon replaced the ivory and human teeth used up to that time.

Toward the middle of the century, Goodyear accidentally discovered the vulcanization of rubber. He experimented and improved it, and among the many uses he found for it was in the making of the rubber or vulcanite denture base. Dentures were now made available to the populace, as they could be produced much more cheaply. And they were better fitting. So a wonderful discovery for the benefit of humanity must be credited to Goodyear. The rubber denture, because of its practicability, can still be well called the poor man's friend.

Soon after this, Hyatt and others introduced the cellulose base, which, in its improved form, maintains a place for itself in modern denture practice, mainly for dentures inserted immediately after extraction of the natural teeth. Evans, Bonwill, Balkwill, von Bonherst, Christenson and others worked on the articulator and balanced occlusion problem, and Walker, toward the end of the century, produced an adjustable articulator that was twenty years ahead of his time.

In the early years of the present century, Snow introduced the facebow, a practical device of great convenience, and a necessity for proper orientation of the casts on the articulator.

There is little excuse for not using the facebow. Arbitrary mounting on such articulators as the "plain line," the "balancer," etc., often leads to great error in establishing the plane of occlusion, thus rendering balance out of the question. Such articulators are worse than Gariot's plaster block, because, with a faulty mounting, their arbitrary movement multiplies the error. It should be generally understood that the edentulous ridges are usually out of conformity anteroposteriorly or from right to left with a horizontal plane at right angles to the sagittal plane, and if this anatomic or acquired error is reproduced on the articulator by the use of the facebow, the proper plane of occlusion for both esthetics and function can readily be established.

In 1910, C. E. Luce, of Germany, produced an articulator embodying the fully adaptable or three dimensional principle.

*Paper received for publication, Oct. 7, 1935.

*Read before the Section on Full Denture Prosthesis at the Seventy-Sixth Annual Session of the American Dental Association, St. Paul, Minn., Aug. 8, 1934.

This discovery is of great scientific value, but was overlooked for about twenty years, when Homer, Hall and later Stansbery and others built articulators following this principle. These instruments do not demand the use of the facebow, but they are both impractical and unnecessary for use in a busy practice.

Luce equipped his instrument with an incisal pin. This or its equivalent is an essential feature in any practical articulator. At about the same time, Gysi did an excellent work in analyzing jaw movements, and taught a technic of obtaining centric relation of the jaws by the use of the Gothic arch tracing. He also built

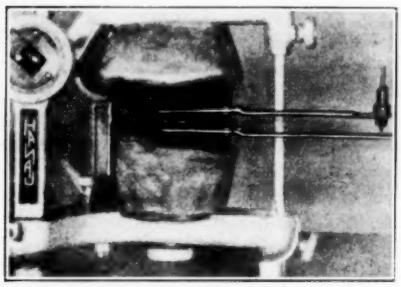


Fig. 1.—Balance in centric relations obtained by means of central bearing point and gothic arch tracing.

an articulator similar in principle to Walker's.

At about the same time, there appeared a crusader whose efforts resulted in the production of more natural appearing porcelain teeth. No one has done more to add happiness to the lives of edentulous patients than J. Leon Williams. After a breathing spell of a few years, the profession was again bombarded with a horde of new articulators each having great claims made for it, and most of them based on fantastic theory. Through the whole history of research in denture prosthesis, altogether too much time and effort has been wasted on the articulator problem. This has been very confusing to the profession. Hanau's brilliant studies about this time began to clear the air. His work proved that we were not dealing with condyle paths and jaw movements alone, but that these factors were influenced by the resiliency and like effect of the denture supporting tissue, and that the articulator movements must not be a reproduction of anatomic movements but rather the equivalent of them. The articulator is not the most important item to be considered in the construction of artificial dentures. It is simply a convenience. Any substantial instrument with adjustable condyle slots and an incisal pin is sufficient.

Phillips gave us the central bearing

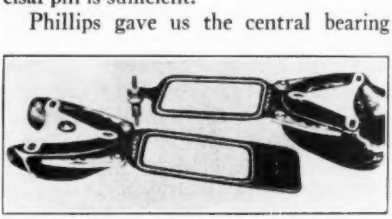


Fig. 2.—Hight tracer, one type of apparatus used for this purpose. The Siddall central bearing tracer used alone or in conjunction with the Dentists' Supply Company gothic arch tracer is also very convenient.

point method of obtaining jaw relation records. This, used in combination with the Gothic arch tracing and the intraoral checkbite, constitutes a great forward step in our technic in the mouth. I regard this step in technic as the most important of all of our procedures leading to the production of successfully functioning dentures. (Figs. 1-2.)

It is just now beginning to be understood generally that the only mandibular movements which prosthetists need be concerned about in building practical dentures are of such minuteness (usually only a millimeter or two) that it is im-

possible to adjust accurately mechanical paths in the articulator mechanism from one jaw relationship point to another; that so-called bilateral balance is not nearly so important as the leverage problem (making provision for the line of stress to pass through or near the crests of the ridges [Fig. 3]) in arranging artificial teeth; that the three dimensional articulator is necessary only where anatomic or cuspid teeth are used; and that anatomically cusped teeth should not be used in full denture work unless altered, because, owing to the inevitable shifting of the bases, cusp interference soon develops, often leading to destruction of the ridges.

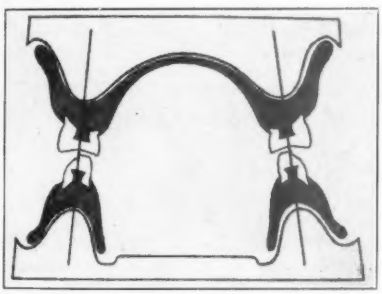


Fig. 3.—Line of stress passing through crests of ridges.

The use of the nonanatomic posterior tooth does away with this trouble to a large extent, because considerable shifting of the lower denture in its relation to the upper can take place without throwing the case out of balance, as there is always a strong tendency of the lower denture to work forward.

To Victor H. Sears goes the credit for advocating and producing the first modern nonanatomic posterior tooth. (Fig. 4.) Besides the Sears channel tooth, we have the Hall inverted cusp tooth and the French posterior teeth. Dayton D. Campbell has suggested partly grinding off the cusps of a regular cusped tooth so that it functions as a cuspless tooth. (Fig. 5.) A number of years ago, the late Rudolph Hanau called to my attention the fact that cusp interference could be done away with to a large extent by grinding off the transverse ridges in the anatomic posterior porcelain teeth. (Fig. 6.) This is also a practical procedure to follow for those who may prefer to use the regular posterior teeth. It produces an occlusal surface which is similar to that of the Sears upper posterior tooth, but the lower teeth are too broad for most cases. I have heard Dr. Gysi read a paper defending the theory of his cusped posterior tooth, but I have also heard him wax enthusiastic in private conversation about the results to be obtained with his cross-bite

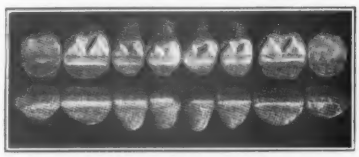


Fig. 4.—Sear's channel posterior teeth.

posterior teeth, which are not only nonanatomic, but, when used as suggested, also take care of the leverage problem.

Now what does all this mean? Simply this: These leaders in prosthetic thought admit that the anatomic posterior is not a practical tooth to use in full denture work, because the conditions under which natural and artificial teeth function are entirely different. The natural tooth anchored as an individual unit in the jaw bone can accommodate stresses which prove disastrous to artificial teeth. The idea of the nonanatomic tooth is not a new one at all. A hundred years ago, the dentist knew dental anatomy well enough to carve beautiful anterior teeth (Fig. 7), but he did not handicap himself

by carving beautiful posterior teeth. He simply made grooves or sulci on flat occlusal surfaces. (Fig. 8.) Perhaps he observed that the natural teeth which lasted longest were worn cuspless or to very low cusp height.

Ten pounds pressure exerted against 45 degree cusps results in 10 pounds lateral thrust, while 10 pounds pressure against 20 degree cusps results in only 3½ pounds lateral thrust. Lateral thrust is ruinous to artificial dentures, causing a shifting or skidding movement, which results in irritation and absorption of the supporting tissues. It is even ruinous to natural teeth unless the alveolar bone is normal and strong.

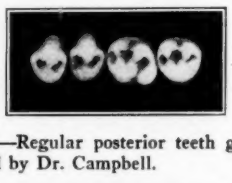


Fig. 5.—Regular posterior teeth ground as suggested by Dr. Campbell.

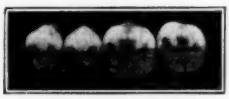


Fig. 6.—Regular posterior teeth ground as suggested by Hanau.

The Sears tooth allows for the forward shifting of the lower teeth and, at the same time, provides for lateral balance, as the upper teeth in position have what is in effect continuous buccal and lingual cusps with a channel running between. The lower teeth, in place, constitute one continuous sharp cusp, which functions in the channel. The tooth designed by Hall has, instead of cusps, saucer shaped sulci with sharp cutting edges. While it is not possible to obtain lateral balance with these teeth as dictated by most articulator technics, I question whether this is necessary to obtain practical results, because, in my own experience, the dentures on which the Hall teeth were used have proved to be very practical and satisfactory, requiring little rebasing service and no regrinding. (Fig. 9.)

The reason for this probably is that, in the masticating stroke, stability of the dentures is dependent more on providing that the line of force passes through or linguad from the crest of the ridge than on balance from the other, or so-called balancing, side of the dentures, since the teeth do not come in contact until they are very near to centric relation. Balance in centric relation is therefore highly important; in fact, the most important single factor in the mechanics of successful dentures. With this requirement attained in our technic in the

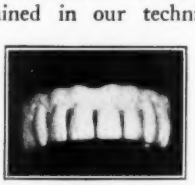


Fig. 7.—Beautifully shaped anterior teeth, probably more than a hundred years old, carved from a single piece of ivory. (From the collection of H. E. Friesell.)

mouth, very practical dentures can be built on the Gariot type, or all plaster, articulator (Fig. 10) or a Hooper duplicator by simply setting the teeth to a curved template of about 33 degrees. We are indebted to George W. Monson for impressing on us the advantage to be gained by setting the occlusal surfaces of the teeth to correspond with the curve of a segment of a sphere. I know of no easier way of producing a smoothly operating occlusion.

In obtaining balanced centric relation in finished cases, refitting jobs or checking centric relation in old dentures, it is best to obtain the gothic arch tracing

intra-orally as advocated by Siddal. In this case, the plate on which the tracing is made is attached to the lower denture with modeling compound and the tracing pin, which is threaded into a nut, is attached to the palate of the upper denture also with modeling compound. If the tracing plate is made of glass, the pinpoint may readily be seen from the under side, when the pin is at the apex of the tracing. (Fig. 11.) The upper and lower dentures are locked in this position with modeling compound checkbites placed in the bicuspid-molar region on either side, and having the patient close on the soft compound.

The tooth designed by Felix French might be described as a compromise between the Sears and the Hall tooth as regards occlusal form. In the esthetic effect on the buccal aspect, it is superior to either of them. The lower teeth are also narrow, allowing adequate tongue space even when the teeth are placed linguad from the crest of the ridge. The lingual surfaces are more definitely anatomic in form than any posterior tooth on the market today. The upper teeth, like the Sears type, have no cusp height mesiodistally, but low cusp height bucco-lingually to make possible bilateral balance. The French teeth have given very satisfactory results in my hands. (Fig. 12.)

I regard the introduction of the non-anatomic posterior tooth and the technic of obtaining balanced centric relation described above as the most important contributions ever made toward the problem of producing comfortable and efficiently functioning dentures.

Next in importance to balance in centric relation is balance in protrusive relation. With a suitable checkbite, this requirement can be conveniently met by using any substantial articulator with an anterior pin and adjustable condyle slots at the rear. A working knowledge of the laws of articulation given us by Hanau is an aid here in establishing the plane of orientation and setting the teeth to balance. Little or no overbite should be used as a rule, and plenty of clearance should be provided between the anterior teeth, while the posterior or masticating teeth are functioning. We have all observed the destruction that results to the ridge when the anterior artificial teeth have masticating stress applied to them for any great length of time. In certain cases, where, for esthetic effect, it is deemed necessary to use considerable overbite, it is advisable to provide posterior balancing contact in the lower base material, distad from the second molar rather than use too steep a curve of Spee. (Fig. 13.) Clearance between the an-

Fig. 8.—Posterior teeth carved in ivory, having no cusp height, simply grooves and sulci. (From the collection of H. E. Friesell.)

Fig. 9.—Early porcelain teeth with baked-in sulci and grooves. These teeth are similar to the Hall teeth, but have twice the number of saucer-shaped sulci. The second molar, having been ground, shows the porous texture of these early teeth. (From the collection of H. E. Friesell.)

terior teeth is more necessary in this case than where little overbite is used.

In the past, most of the research affecting artificial denture work has been conducted by persons of an inquiring turn of mind, working on their own time and at their own expense. While these men deserve no end of praise and encouragement, organized backing for the work is just ahead, and suggestions may be in order for subjects for research about which more knowledge is badly needed. We now see certain of the dental schools encouraging research in this field and, as a result, we find W. H. Wright contributing valuable anatomic and histo-

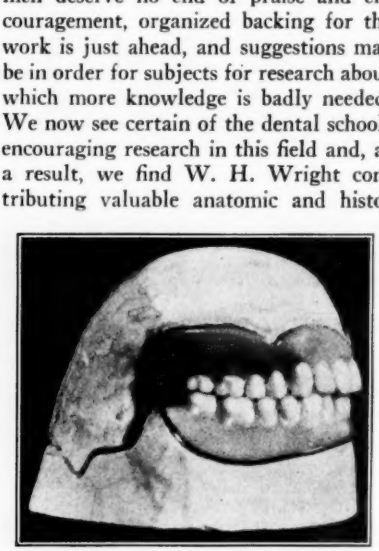


Fig. 10.—Gariot type of articulator.

logic studies on the structure of the temporomandibular joint and denture supporting ridges, as they are affected by traumatic stresses; and E. C. Pendleton studying the normal denture supporting areas histologically from the point of view of the prosthetist. This type of work should be encouraged in all dental schools.

Some work has been done on the microscopic flora of the mouth as affected by the different denture base materials. There is a need of a more thorough study here. Knowledge is lacking in regard to calcium metabolism of the alveolar ridge. This subject will provide a worthy work for some organization. The increased cost of gold has recently stimulated research in quest of substitutes. Interest has been revived in the silver palladium alloy group. A dozen years ago, when these alloys were introduced, their cost was greater than that of gold. Now they are considerably cheaper, and we are at present observing notable developments here, as these alloys have merit. The A.D.A. Fellowship at the Bureau of Standards should keep a careful check on the gold substitutes lest the cost fall too heavily on the dentist.

The Fellowship at the Bureau has contributed valuable research data and has laid down specifications on the following materials used by the prosthetist: model-

Fig. 11.—Glass tracing plate suggested by Dr. Sheffield mounted on finished lower denture.

ing compound, waxes, investments, plasters and gold alloys wrought and cast. Because of its work, vastly improved materials are now available. There must be no curtailment of the support given this work by the A.D.A. since it saves the dentist many times its cost by directing him away from inferior materials. The research at the Bureau has set up standards which reliable manufacturers have been quick to meet, and, as a result, we now have casting alloys that more nearly meet our requirements as to strength and durability and, in the case of cast clasp work, a degree of adjusta-

bility that was not possible a few years ago. The work of the Fellowship at the Bureau up to date has been of little aid to the dentist struggling with the full denture problem. I have been informed that a study of denture base materials is now under way and we may look forward to relief from an almost intolerable situation that has arisen through the marketing of the newer base materials.

We have witnessed frantic haste on the part of the dental dealers to get a satisfactory natural-appearing denture base material on the market and beat their competitors to the lucrative profits. Outlandish claims have been made for each new material as it appeared and the dentist has been the victim. These faulty products have caused the profession an

Fig. 12.—French's lower posterior teeth.

immense financial loss, and the laboratories also have suffered heavily. The sale of materials, successful for other purposes, has been pushed by dental sales organizations even where the manufacturer would not permit his name to be used on the product.

About seven or eight years ago, two new base materials, "iteco," a phenol formaldehyde resin and "hecolite," an improved cellulose compound, were introduced on the dental market. These materials, oddly enough, have remained on the market, and have not been improved on, except in one instance, by any of the dozens of products introduced since that time.

Claims of superiority were made for each new material, but many of them were such outstanding failures that the profession suffered the tremendous financial loss referred to above.

Recent literature contains articles by dentists lauding materials so deficient in merit that it would be difficult to find a laboratory foolish enough to produce one. I will group the different materials and comment on them, not from a sales organization point of view, but from experience fully paid for.

METAL BASES

The metal bases are the oldest of them

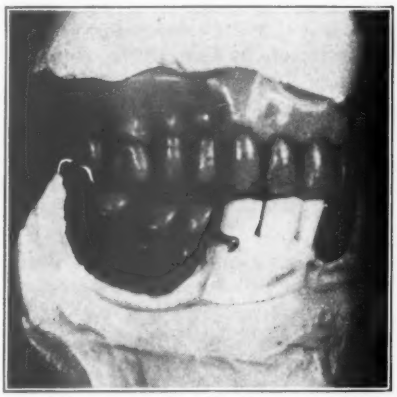


Fig. 13.—Mandible in protrusive position and upper denture balanced on lower vulcanite posteriorly because of unusually deep overbite.

all. When properly swaged, of suitable alloys, gold, palladium-silver or chromium-iron alloys, they are unexcelled by any base, but they are, of course, usually constructed in combination with one of the plastics. They are also available to but a minority of our patients. They rank first in thinness, cleanliness, thermal conductivity and favorable action on the tissues. They exhibit no shrinkage or warpage during construction of the den-

tures, unless a too soft, unsuitable metal is used.

Vulcanite, with almost a century of successful background, must be considered the standard by which the other plastics are gaged. Working from metal dies instead of the varying mouth tissues, and with the modern equipment available at the Bureau of Standards, we may confidently await some interesting and valuable data from the A.D.A. Fellowship experiments.

VULCANITE

The satisfactory qualities of vulcanite are: strength, durability and ease and cheapness of construction and repair. The unsatisfactory qualities are: poor esthetic value and poor thermal conductivity, some shrinkage and warpage in curing and need for considerable pressure in closing the flask. In the present economic situation, there is much weight in its favor.

CELLULOSE

The satisfactory qualities of cellulose are: the fact that it is the toughest and least subject to fracture of all the plastics, its esthetic values are fair and it is easily repaired. Its unsatisfactory qualities lie in the fact that it discolors in the mouths of tobacco users; while it exhibits no shrinkage or warpage in curing, a shrinkage, due to the evaporation of the volatile ingredients, occurs unless it is constantly kept wet, and very heavy pressure is required in shaping it. This pressure may cause teeth to fracture if the investment is very hard, and the palates to thicken if the investment is too soft. This part of the technic is therefore exacting and not attainable in 100 per cent of the cases.

PHENOL-FORMALDEHYDE RESINS

The phenol-formaldehyde resins were not more than 50 per cent satisfactory as regards strength and color permanency, in my hands, until the resin "luxene" was accidentally discovered in seeking a repair material for glycine. Satisfactory qualities are, first, that this material (luxene) outranks all the resins in color permanency, and secondly, its strength is fairly satisfactory. The surface is dense and stains do not penetrate, but it has nothing like the hardness of porcelain as some enthusiasts have proclaimed. Thirdly, it has an excelling quality in the fact that very little pressure is required in closing the flask; which insures undisturbed occlusion and no thickening of the palates.

The unsatisfactory qualities are: first, that it is more costly to produce than rubber, both as to materials (which should be cheaper) and time consumed in the fabricating; secondly, repairs are three or four times more costly and time consuming than vulcanite repairs, but can be successfully made, with but slight loss of color, and thirdly, it is not so strong as rubber.

The claim is now being made of "iteco" and some of the other phenol-formaldehyde resins that their strength and color permanency have been improved. The improved phenol-formaldehyde resins have become almost indispensable, particularly in those cases in which the gums are exposed in smiling. While this class of resin is probably here to stay, experimenting with it has been rather expensive to the profession.

VINYL RESINS

The vinyl resins are obtained by subjecting natural gas to very great pressure. The residue thus obtained is processed and colored and is supplied to the profession in the form of blanks. The product was supplied to us before a suitable technic had been developed and the

frequent failures have been altogether too costly.

The color is satisfactory, but the percentage of fractures has been very high when the recommended technics were followed. Owing to the fact that an occasional case exhibits unusual strength, a satisfactory technic may be developed which will produce dentures of consistent strength. The fact remains that this product was introduced before it was ready for the market, and its use has caused altogether too much trouble and financial loss. Like the cellulose base, it requires a great pressure to shape it, and it is not at all readily repaired.

None of the foregoing plastics, vulcanite, cellulose, phenol-formaldehyde or vinyl resins change shape because of heat encountered in the mouth, but none of them will withstand anything like boiling temperatures. Just why some investigators boiled the cellulose denture in glycerine to demonstrate that it would change shape is beyond me. The claim that thermoplastics tend to revert to their original form, which is flat, can be dismissed as of no importance. What little warpage I have observed has taken place in the other direction. If this trouble did not exist, it could be prevented by cutting the blank into four pieces, before pressing it into the denture form.

The styrol type resin sold under the name of tepperite is a complete failure as it lacks the strength necessary for service in the mouth. Its color was satisfactory.

The alkyd resin glycine has turned out to be such a failure that it has just about disappeared from the market. It was said to have great color permanency, but it changed color quickly. When newly finished, the material clung to the porcelain teeth very tightly, but after short service in the mouth, in many cases, the teeth loosened to such an extent that they could be pushed out with the finger. The technic also was impractical, requiring about two days' curing. The last two mentioned resins should never have been put on the market, as they left a trail of loss and grief in their brief stay.

Esthetics is the most important factor in a denture in the estimation of the patient. A questionnaire addressed to a number of leading prosthetists on the subject places esthetics first, comfort second and masticating efficiency third.

Since this factor is paramount, the subject of esthetics both as to denture base materials and porcelain teeth is crying for a solution.

Little improvement in porcelain teeth has been made since Williams' work. Recently, one of the manufacturers, at probably great expense, brought out a new line of teeth, which fall far short of the goal. While definite improvement in form is noted, the color effect is disappointing, the new teeth actually having fewer usable shades than the ones that they were intended to replace. The colors are too bright and there is too much variation in color from gingival to incisal. In most of the numbers, the color change in the set up case occurs abruptly in a horizontal line. They were admittedly made to imitate the teeth of the very young adult, while our problem is to blend the artificial with the teeth and complexions of patients usually 45 years of age and upwards. Apparently also, the fairly rare type of tooth quite translucent at the incisal aspect was set up as the ideal. If this manufacturer would make available a few of the popular old shades, such as No. 9, in the new molds, many of us would be grateful. I know of no color guide which contains more than a half dozen usable numbers in the customary twenty-five. There is also room for improvement in the strength

of the teeth. All mold guides are also overloaded with forms rarely seen in natural dentures.

Some alert manufacturer will eventually bring out a line of teeth containing far fewer of the smaller molds and about one half the usual number of shades.

1020 Rose Building.

MODERN FIXED PARTIAL RESTORATIONS*

By ALVER SELBERG, D.D.S., San Francisco, Calif.

Progress is not an Accident, it is a Necessity.

FUNDAMENTALLY, the basic materials used in fixed bridgework have changed very little in the last few years. We are still working with gold or gold alloys and porcelain, depending on cement for a sealing medium. Neither gold nor porcelain individually can be accepted as suitable materials for this purpose because of the objectionable color of the gold and the brittleness of the porcelain. When they are used in combined form, as in making a fixed replacement, they add value to each other. The undesirable color of gold is concealed by the porcelain or the facial surface of the natural tooth, and the porcelain facing or natural tooth in turn is supported and protected by the gold. For modern fixed partial restorations, these materials, although not ideal, are accepted and used because they are still the best available.

Present-day literature on the mechanical phase of bridgework deals almost entirely with the manipulation and application of these materials. The changes and improvements are taking place so rapidly that textbooks on the subject have been unable to keep up with the progress of technical variations and improvements.

The technical and mechanical principles which we apply today are the result of contributions made by a long list of dentists, which must include the names of G. V. Black, Taggart, Tinker, Herman and Theodore Maves, Monson, Meyer, Orton, Burgess, McCollum and scores of others who have helped to advance the art to its present important place in dentistry.

Sometimes, under the stress and urge of accomplishing one phase of fabricating a replacement, we may overlook a simple fundamental step; which later may reduce to a minimum the durability of the replacement. The purpose of this paper is to present a brief résumé of basic requirements relative to fixed partial replacements. These requirements may be grouped under the following heads: (1) protection, (2) comfort, (3) esthetics, (4) durability and (5) utility.

PROTECTION

The primary purpose of fixed partial restorations is protection—the protection of the teeth, gingival tissues and bony supporting structure, which, in turn, guard the health of the patient. Such an important consideration cannot be overstressed. Any dental operation which

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may in any way cause or contribute to disease or ill health is in complete antithesis to the purpose of dentistry and must be condemned. The fact that certain pulpless teeth are apparently harmless hardly justifies their preservation, when we know that they may cause a score of diseases and damage the health. To quote Herman Maves: "It has been my experience that we cannot promise immunity to any patient with restorations on pulpless teeth longer than twenty-four hours."

The first duty of the dentist is to place the gingival tissues in a state of health.

After fixed bridges are placed, the patient should be shown how to pass dental tape between the tips of the pontics and the soft tissues of the ridge, and, at the same time, how to clean the margins of the abutment attachments. Instruction in the home care of fixed partial dentures is almost entirely neglected, even though it is of so much importance to the life of the replacements and the health of the surrounding gingival tissue.

Conditions that are the source of irritation, with possible further pathologic complications, should be eliminated.

Traumatic occlusion or functional disharmony will invariably cause irritation of the surrounding structures and shorten the life of the abutment teeth. "High spots" should be relieved not only at the time the bridge is cemented, but also at a later appointment, after the patient has used the bridge several days. Mastication often produces evidence of traumatic occlusion that otherwise may be easily overlooked.

The tips of the pontics for immediate replacements should be highly glazed and barely extend into the socket. Porcelain saddles should not blanch the tissues, but should just touch the mucosa of the ridge.

COMFORT

The comfort of the patient should be considered at four different periods:

1. During the preparation of the abutment teeth. A stream or spray of warm water directed on the tooth greatly reduces the heat caused by friction of the stones or burs. It should always be used to protect the pulp against excessive heat. Procaine is used in most cases because it enables us to make a much more accurate preparation.

2. At the time the laboratory work is being done. The open teeth should first be coated with a sealing preparation such as copalite, and then protected with zinc oxide and eugenol in a metal or celluloid cap placed over the tooth.

3. During the time the replacement is being cemented. Much of the discomfort of cementing can be eliminated by properly mixing the cement. Rapid incorporation causes the mixture to generate more heat and to set too rapidly.

4. After the replacement is finished. Thermal shock to the pulp may be partly eliminated by proper depth of the preparation and by relieving the casting in such a manner that a thickness of cement will act as an insulating medium. This relief should not extend closer than a millimeter from the margin of the casting.

Abnormal contouring of the pontics, especially the lingual surfaces of the upper anterior incisors, may interfere with speech and be a source of irritation to the patient.

Functional disharmony is always a source of discomfort. It is an extremely important consideration and concentrated effort is required to produce a replacement in correct occlusion.

The surfaces of the porcelain facings must be glazed and the gold surfaces highly polished in order to assure comfort.

ESTHETICS

No artist is confronted with the many difficult color and light problems that a dentist faces in constructing anterior bridgework. The work of the artist is displayed only under favorable light conditions; whereas, the dentist has his work observed under all possible light conditions. The work of the artist is viewed apart from his subject, while the patient has the natural teeth present for constant comparison. It is the one demand that the patient immediately recognizes.

The selection of facings with reference to color is very limited when the thousands of different color combinations confronted in practice are considered. Therefore, the operator, in many cases, is compelled to alter the colors of the facings by staining or grinding and baking the correct color into the facing.

Anterior pontic-tips should be contoured so as to reproduce the natural teeth. Tips that are narrow mesiodistally form wide embrasures, which detract from the natural appearance of any denture.

The objectionable display of gold has gradually forced operators to minimize the showing of the metal to the extent that durability in many cases has been sacrificed at the expense of esthetics. A safe balance must be determined, and the judgment of the operator for each particular case is the only guide.

Extension for prevention should be reduced to a minimum for anterior attachments, and when the case requires posterior abutments, the margins should be progressively extended more toward the buccal and lingual surfaces of the teeth. The attachments most used for anterior teeth are the partial veneer and the pinledge crowns, modifications of each or combinations of partial veneer and pinledge crowns. In cases wherein a small part of the labial surface is removed by caries or operative restorations, the missing labial enamel may be replaced by silicate cement, gold foil or porcelain inlays.

In cases wherein a large portion of the enamel has been destroyed, a full cast gold crown is made with a porcelain facing to replace the labial enamel. These may be made from manufactured facings or may be baked by the operator.

The so-called thimble crown cannot be safely used, because the porcelain is unprotected by gold and is further weakened by cutting of the proximal surface for gold union with the proximating pontic. Their use should be limited to the upper central incisors, and they should then be used only in very few and exceptional cases.

The color of cement used for anterior bridgework should be tested by mixing the cement powder with water until a satisfactory color is obtained.

DURABILITY

The durability of a fixed bridge cannot be definitely determined, because of many factors over which the dentist has little or no control. The general health of the patient is often reflected in the mouth—not only in the soft tissues, but also in the bone structure and composition. The enamel, dentin and saliva also are affected by disease conditions, which, in turn, may shorten the life of the restoration.

Even accidents may limit the durability of fixed bridges.

Sometimes, fixed replacements are necessary on irregular teeth. In many of these cases, the force of mastication is directed contrary to the normal. This obviously affects the life of the abutment teeth. The length of the span and the force applied on the teeth naturally affect the durability of the fixed bridge.

The home care of the teeth and mouth has a great bearing on the life of all den-

tal replacements, and we as a profession must continue to instruct and teach patients the value of proper brushing and home care of the mouth.

Following are the procedures that depend on the diagnosis and technical execution of the operator:

I Preparation of the mouth for the fixed replacement, which consists of:

A. Thorough prophylaxis and general examination of the mouth by aid of study casts and roentgenograms. If the latter have as their purpose outlining the pulp chamber, in taking the picture, the rays should be directed through the coronal portion instead of the apex of the tooth. Roentgenograms also should be used to determine the length of the teeth, the bone structure and the presence of caries, root fragments, cysts and foreign particles in edentulous areas. They are also of great value in revealing the amount of soft tissue and also hypertrophied soft tissue that often is present adjacent to the gingival areas of the molars. Teeth with crowns surrounded by hypertrophied tissues should be treated surgically first. In some cases, it is expedient to remove irregular proliferated ridge tissues by surgical operation for the sake of sanitation relative to the pontics. A more nearly ideal length for pontics can also be assured by removal of these tissues. The percentage of cases that require this procedure are relatively small.

B. Prepartion of the abutment teeth. The strength of the retaining forces of the attachment depends primarily on "frictional wall retention" and the interlocking of the cement between the prepared surface of the tooth and the casting. Therefore, the surfaces of the prepared tooth should not be polished and all castings within a millimeter of the margins should be roughened and relieved with a small stone. This retention is augmented by the use of parallel walls and the retention is influenced proportionally by the size and length of these parallel walls.

In almost all cases, the mesial and the distal surfaces of the teeth offer the natural formation for the making of parallel surfaces, and advantage is taken of this fact.

Anterior attachments: The partial veneer (three-quarter) crown with its many modifications and variations is today by far the most popular anterior attachment. Its conception is the result of demands made by the patient for a consideration of esthetics. Time has proved it to be a good attachment when properly made, and today, owing to the efforts of the clinicians, the instrumentation for its preparation is almost standardized.

Modification and variations: The pinledge crown has reached popularity only in certain sections of the United States. This is due mostly to the false opinion that there is extreme danger in using it because of possible pulp involvement. Extreme caution should always be used. The incisal pins should be placed no nearer the pulp than the corresponding grooves of the partial veneer. The pins can be placed in the dentin just inside the mesial and distal enamel. They provide more than sufficient retention and the pin holes do not need to be drilled deep, especially when threaded or knurled wire is used for the pins. This wire should fit the pin holes snugly, and a vent for the cement to escape during cementing should be made with a 000 round bur inserted into the bottom of the pin hole and withdrawn, a groove resulting which will counteract the plunger effect during cementation.

Lingual attachments for anterior teeth depend on the use of either grooves or pins plus parallel walls for retention. The mesial and distal grooves of the partial veneer (three-quarter crown) assure the greatest retention when they are parallel.

The incisal groove serves the purpose primarily of reinforcing the lingual gold to keep the crown from spreading. In cases wherein there is caries or an operative restoration interfering with the placing of the mesial and distal groove, it is a common procedure to increase the retentive force by using a pin or post in the cingulum of the tooth. The retention of three-quarter crowns, with the exception of the post in the cingulum, depends, therefore, almost entirely on the interior of the "staple" formed by the mesial incisal and distal grooves of the crown; while the means of retention of the lingual pin crown can be compared to a driven staple. Each pin is a retention form in itself, and, for that reason, not much thickness of gold need be used on the lingual surface, and the incisal groove can be dispensed with. Pin retention is one of the strongest retentive forces mechanically that can be used in dentistry. The pins in the tooth need not be placed in most cases over the depth of 1 mm. Many operators say that the holes for the pins in the teeth do not necessarily need to be placed parallel, because the pins of the crowns can be smaller than the holes in the teeth. If the pins in the crown are of sufficient size to hold the crown, it seems a foolish sacrifice of vitally important tooth structure to drill a hole that is larger than is necessary. The holes for these pins can be drilled parallel mechanically, regardless of the number, and the pins can then be fitted snugly into them.

This type of an attachment offers a great amount of retention, and this advantage is sometimes classed as a disadvantage, because it is claimed that if the decay starts under this attachment, the pins hold it firmly to the tooth and allow the decay to progress undetected. A large percentage of such decay could be eliminated by proper care of the prepared tooth at the time when the laboratory work is being done on the bridge. In many cases, these cavities prepared for cemented restorations are allowed to go out of the office without any protective covering, and the crown is cemented without removal of the bacterial plaques and materia alba which have formed on the tooth. We have created an ideal condition for bacteria to thrive, because the prepared tooth is roughened with stones, and moreover the patient cannot brush these teeth because they are sensitive. These bacterial plaques take up space, and while they are immediately destroyed when a crown is cemented over them, they have caused a space to be left between the cement and the tooth, and consequently a "leaky" margin is formed. Disclosing solution (glycerine plus Lugol's solution [compound solution of iodine] or mercurochrome) should be used before any cemented crown is placed and then the teeth should be thoroughly scoured with pumice to remove this film. This precaution is just as important as good adaptation between the castings and the tooth. The incisal pins for this crown should be placed in the dentin just inside the mesial and distal enamel plates. In this position, there is no danger of pulp involvement. This type of crown has advantages and possibilities of variation that no other attachment affords. It has a definite place in dentistry.

Inlays used as posterior abutments must be prepared to proper depth, with definite internal angles. The wax pattern must extend into these angles, and when the casting is completed, it must be properly relieved for the insulating cement, even though it fits correctly without relief. On the occlusal surface, the margins should extend sufficiently upon the planes of the cusps to expedite finishing of these margins and to support the cusps. Fracture of the cusps is not

always caused by the external force of mastication, but may be induced by internal pressure when the inlay fits too tightly against these surfaces. A line of fracture may even be started at the time the inlay is cemented, only to break off later, the force of mastication being blamed for the failure. The internal surface of the casting should be carefully examined with a magnifying glass for nodules or other flaws which may be present on these areas. When the casting is being cemented, continued and hard hand pressure should be used, aided by gentle taps from the mallet. It requires strong continued force to accurately seat any inlay that must be cemented.

As regards bicuspid and molar attachments, the standard groove three-quarter crown is the poorest of all abutments. Close observation has revealed the fact that it contributes to more failures when used on these teeth than any other attachment. A false conception of the retentive qualities of this attachment must be responsible for these failures. When the occlusal surface is reduced for thickness of metal, this almost flat surface can contribute practically nothing to retention. Obviously, the mesial and distal length of the crown is reduced a corresponding amount. From the anatomic standpoint, the occlusogingival length on the distal aspect is always shorter than the similar measurement on the mesial. It is, therefore, the distal surface which it is difficult to prepare with sufficient retention. It is made still more difficult when an approximating tooth is present, limiting the area of access. Moreover, the posterior position in the arch, plus the necessity of using a contra-angle to make the groove on this flat and short surface, practically precludes any possibility of an accurate and definite preparation. Definite and accurate work of inlay preparation is done entirely in dentin, and therefore we have sufficient access. An inlay cavity can be made more accurately and consequently with a much more accurate fit than the standard three-quarter crown. Therefore, this crown should be used only in rare and exceptional cases. In bicuspid and molar abutments in which inlays may not provide sufficient retention, a much more practical preparation is that of a shallow mesioclusodistal cavity with its qualities of retention and stability augmented by reducing the lingual or buccal cusp and extending these margins as far gingivally as the case requires.

Class II (mesioclusal and distoclusal) inlays should rarely be used for bridge abutments and then only as the rest attachment for the so-called "broken-stress bridges."

The full veneer gold crown is universally accepted as the most durable attachment of all. It provides the maximum retention with the minimum amount of dentin sacrificed. It not only provides this retention, but also acts as a protective veneer.

C. Choosing attachments.

The determining factors in choosing attachments are: (*a*) the condition of the teeth with regard to prevalence of caries or operative restorations; (*b*) the length of the crowns and the roots of the teeth; (*c*) the shape of the crowns of the teeth; (*d*) the length of the span involved in the fixed partial restoration; (*e*) the occlusion and articulation of the case; (*f*) the strength of the masticating apparatus; (*g*) the patient's wishes; (*h*) the contact of adjacent teeth; (*i*) the age and sex; (*j*) the personal habits with regard to mouth sanitation; (*k*) the alinement of the teeth; (*l*) the condition of the enamel of the teeth to be used as abutments; (*m*) the exposure of the teeth in smiling, and (*n*) the type and temperament of the patient.

II Outline form:

Extension for prevention is practiced for fixed partial restorations in practically the same manner as G. V. Black advocated for operative procedures.

III Bevels for inlays:

Bevels serve two purposes: to protect the enamel rods and to facilitate marginal adaptation of the gold. The occlusal and gingival bevels are important and should always be used.

IV Materials:

The subject of materials is most thoroughly covered by the Bureau of Standards and the Research Commission of the A.D.A. and can therefore be omitted.

V Solder joints:

Many failures of fixed partial restorations are caused by breakage of solder joints. This technic should be accomplished with care. The solder should be placed in such position that it does not interfere with the passing of dental floss between it and the soft tissues of the ridge. It should be placed where contact is normally formed between the teeth. Fred S. Meyer, of Minneapolis, employs a method of making a fixed replacement in one casting which practically eliminates possibility of breakage at these points. Ferdinand Neurohr, of New York City, has devised a posterior fixed removable bridge which permits removal by the patient. It, therefore, combines most of the advantages of both the fixed and removable means of replacing lost teeth. S. E. West, of San Francisco, eliminates the use of solder joints between pontics and attachments by using rod and tube unions held in place by small gold alloy screws. This permits removal of the pontics in case of fracture. It also allows such alteration of the porcelain as may seem best. A much more thorough examination or repair of the attachment margins may be given at the time of prophylaxis. These methods have merit and advantage which cannot be denied.

VI The contours of the pontics and abutment restorations:

These should be determined largely by the natural teeth in each particular case. The most frequent complaint among patients having replacements which include the upper anterior teeth is the overcontouring of the cingulum of both the pontics and the abutment attachments. Palpation of these overcontoured surfaces will immediately reveal the unnatural feeling that these surfaces give to the tongue, which must continually contact these surfaces during speech. These surfaces should be smooth and should reproduce the lingual surfaces.

Contact points have a very important function. Their proper placement should receive concentrated study for each case, because one faulty contact can ruin an otherwise successful fixed partial restoration.

VII Perforated attachments:

Crown attachments should be carefully examined on the occlusal and lingual surfaces for minute holes after the crown has been polished and is ready for cementation. These perforations may be caused by burs or stones in placing the tooth form. Cement disintegrates with surprising rapidity through these perforations and decay may progress undetected. This minor detail has caused the loss of many abutment teeth.

VIII Toilet of the cavity before cementing the prosthesis:

The toilet of the cavity should be considered immediately after preparation of the cavity is completed. Several good preparations are on the market which seal the tubules and protect the raw surfaces of the teeth. Bands or celluloid caps filled with a temporary filling should then be placed over the teeth,

while the laboratory work is being done. To determine whether the preparation is clean, disclosing solution must be used. The common procedure of applying alcohol only to the prepared tooth is not sufficient. Alcohol will not penetrate the film which may be present on the tooth. The only way to remove this is by using a disclosing solution made of glycerine and compound solution of iodine or mercurochrome. The areas which absorb the solution must be thoroughly scoured with pumice for complete removal of it. The drying of the abutments before cementing a crown is essential. This can be accomplished with assurance after the rubber dam has been applied. The rubber dam can be used in almost every case for inlays or in larger replacements. The application of the rubber dam has reached its highest degree of perfection among the gold foil study club operators. Contact with such a group will reveal the enormous possibilities and advantages of its use in cementing in fixed partial restorations.

IX Cementing the prosthesis:

A good mix of cement is essential to the life of any fixed prosthesis. The powder must not be incorporated too rapidly into the acid, and enough should be added to cause setting in about seven minutes. During this time, after the prosthesis is seated, moisture should be excluded and the cement should be allowed to set unmolested.

X Margins of the fixed prosthesis:

The importance of accurate castings has long been realized and the desire for good margins has been evidenced by the profound interest in this subject. The untiring efforts of men interested in the casting process have taken much of the uncertainty out of it, and placed it on a more scientific basis. Visible cement lines today can no longer be blamed on investments or any other phase of the casting process.

XI Finishing of the prosthesis:

Before the prosthesis is cemented, it should be completely carved and the margins stoned and disked. After cementation, only fine pumice should be used before the final polish. Burnishing and "stoning" of the margins after cementation has no place in modern dentistry.

UTILITY

Although many factors may enter into the utility of a fixed prosthesis, it is almost entirely determined by the masticating efficiency. Balanced occlusion or functional harmony enters into every basic requirement. It must always be reckoned as a very important consideration.

CONCLUSION

In summing up the many factors which enter into the construction of fixed prostheses, the importance of detail becomes increasingly evident. These details must be based on these fundamentals: (1) protection, (2) comfort, (3) esthetics, (4) durability and (5) utility. Satisfactory bridgework always shows a balance of all these requirements.

SURGICAL PREPARATION OF THE MOUTH FOR THE RECEPTION OF ARTIFICIAL DENTURES*

By C. S. SUDDARTH, B.S., M.D., D.D.S., Chicago, Ill.

SURGICAL preparation of the mouth for the reception of artificial dentures appears to have been practiced, at least sporadically, much earlier than it is ordinarily thought to have been. I wish to refer to two articles which appeared in an 1876 issue of the *Dental Cosmos*. One by W. G. Beers,[1] of Montreal, follows:

In the *Canadian Journal of Dental Science,* I described an important case of this kind and the ultimate victory obtained over Nature in moulding into a regular and even arch, one of the best imitations of a horse shoe I ever saw behind human lips. Since this heroic treatment (as such operations have been called), I have made a common practice of removing, with a cutting forceps, large portions of the transverse processes, or septa, and the inner and outer plates of the alveolus, especially where the lip is naturally short, the gums and alveolus unnaturally prominent and the prospect is presented that several months' absorption will make the case what it otherwise could not have been—one suitable for gum teeth. After the extraction of the incisors, cuspids, and bicuspids, cut cleanly across the gum down to the process as far as you propose to excise; then slip your knife under and dissect away in one piece. The excision can then be proceeded with, taking care to remove all you cut. I have been surprised to see difficult cases treated in this way, return in eight or ten weeks with a mouth quite as ready for an impression as it generally is in four months when the alveolus is left to the natural process of absorption. Nothing is done in this operation to increase the inflammation which naturally ensues after the extraction of teeth. Astringent mouth washes ought always to be used.

In the same issue of the *Cosmos,* Dr. Atkinson,[2] of New York, writes as follows:

I wish to call attention to the manner of removal of the transverse processes and the posterior and anterior plates of the process for securing a good arch for artificial teeth. The surgical law involved in the removal of teeth is the taking away of these points toward which circulation tends —all that portion which surgeons call "variable parts of the jaw," are the parts which absorb. It is much the best to remove them surgically. I was criticized twenty years ago for advocating that practice. The mode is very simple. Every dentist can do it. After removing all the portions you wish to, in as delicate a manner as possible, lay the flaps of the gums together, cut off the excess so that the margins of the gum will simply coaptate without undue pressure and then with a fold of any thin cloth, cotton or linen, saturated with tannin and glycerine, lay it together, then put bibulous paper between the jaws to make a cushion, and let the patient close the mouth gently, when agglutination will take place without any stitching. Thus, the whole process is simply coaptation, obtaining union by first

*Read before the Section on Full Dentures at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

1. Beers, W. G.: Proc. New York Odontol. Soc., D. Cosmos, 18:118 (March) 1876.

2. Atkinson, W. H.: Proc. New York Odontol. Soc., D. Cosmos, 18:134 (March) 1876.

intention, which I wish to state is always an act prior to what is called "cohesive inflammation," which I call adhesive nonsense.

Thus, we see that alveolectomy was practiced as early as 1850, at least, and no doubt even earlier, but it seems never to have gained general favor until two or three decades ago. In 1905, Dr. Shearer, of Omaha, performed this operation, describing it and advocating it as a surgical procedure, the virtue of which was that it rendered the condition of the oral tissues more favorable for the reception of dentures. After the epoch making work of Dr. Billings on the subject of focal infection, the dental profession naturally became very much engrossed in the eradication of this type of infection. The zeal of some of the more radical and energetic advocates of eradication reached a very unfortunate culmination in the practice and advocacy of so-called "surgical removal" of teeth for the purpose of eliminating oral focal infection. This pernicious practice proved a favorable ally to alveolectomy, giving it a second cornerstone to rest upon, so that alveolectomy thenceforward was not practiced alone as a great boon to prosthetic dentistry, but also as the *sine qua non* in the eradication of focal infection from the periapical regions of teeth. To judge from the literature, alveolectomy seems to have reached its zenith in the early twenties of the present century; although many favorable articles on the subject have been published up to the present day.

The ardent supporters of the principles and practice of alveolectomy have been found among both prosthodontists and oral surgeons. Those opposing the principles of alveolectomy and its ally "surgical removal" of teeth are likewise to be found among both groups. The opinion of leading prosthodontists of today whom I have had the privilege and pleasure to confer with is very much altered from the view of some of the prosthodontists who have written on the subject. One of these men vehemently condemns alveolectomy from a prosthetic standpoint. Those favorable to it are so only to a limited degree, and even then with many restrictions and reservations.

Since the dual reason for alveolectomy is eradication of oral focal infection and effecting a more favorable condition of the oral tissue for the reception of prosthetic appliances, let us without criticism or commendation of those men who have expressed opinions upon the subject either pro or con turn to a higher tribunal than that of opinion: let us turn to facts relative to these two cornerstones of alveolectomy in an endeavor to properly evaluate it!

The first of these, "surgical removal" of teeth for the purpose of eradicating oral foci of infection, can be dismissed as absolutely unsound. Why cut away the entire buccal or labial plate of bone to the apices of teeth for the purpose of eliminating a pathologic condition about or beyond the apices of such teeth, when the same end can be so much better achieved by gaining access to the condition in question by means of a small opening through the thin labial or buccal plate directly overlying the pathologic area in question without sacrificing sound and valuable alveolar bone? In this connection, too, I wish to say that the practice of curetting bone in these places is not only unnecessary, but also fraught with the danger of creating grave systemic disturbance.

Before justification or condemnation of alveolectomy from the prosthetic standpoint, it is necessary to have a clear conception of what we mean by alveolectomy. As described in the dental literature and practiced by the dental pro-

fession during the past three decades, it is briefly and essentially as follows:

Incision is made through the mucoperiosteum, in the region of the alveolar crest, from tuberosity to tuberosity in the maxilla and from retromolar fossa to retromolar fossa in the mandible. The mucoperiosteum is then stripped away from the bone on the buccal and labial aspects, with a suitable steel instrument, down to or beyond the apices of the teeth. From this point, two methods are advocated: (1) removal of the teeth before proceeding further with removal of the process, and (2) removal of all the exposed bone with mallet and chisel before removal of the teeth. When the teeth and labial and buccal bone have been removed, the vigorous application of curets to the periapical bone is advocated; which, if practiced, will certainly break through any protective wall that nature has built up, thus opening up free and easy pathways into the blood and lymph streams for the ingress of septic material. Next, the sharp edges and septums are trimmed away by means of cutting forceps, chisels and bone files, and sometimes by rotating stones. The lingual tissue is now retracted 4 or 5 mm., and the lingual bone smoothed down in a similar fashion. The mucoperiosteal flaps are now trimmed with serrated shears until their margins neatly approximate and then sutured, in many instances very snugly and securely; some maintaining that the more sutures the operator uses, the better the case will be. I feel quite sure that the fewer the sutures used, the better the patient will be. Some drug for the control of pain may now be prescribed and the patient instructed to keep the mouth as clean as possible by the use of suitable mouth washes. Topical applications of some nonirritating drug such as mercurochrome may be advised. The patient is also instructed to use ice caps for control of swelling, which may sometimes be very extensive.

Before passing to the prosthetic aspect, I wish to consider the hazards encountered in alveolectomy from a surgical standpoint. In the first place, although all the precautions of aseptic surgery be observed, we are still working in a septic field, since we have no means of rendering the oral tissues sterile. If we remember that the opening up of the blood and lymph channels, in so slight an operation as scaling the teeth, is often followed by sufficient absorption to cause a rise of body temperature and leukocytosis, it is not hard to conceive that the radical stripping of the mucoperiosteum and extensive cutting into the alveolar bone or bruising the way into it with dull rongeur forceps, further traumatizing and grinding in infective material with whirling stones, may result in sufficient septic absorption to cause an acute exacerbation of a chronic endocarditis, myocarditis, arthritis or nephritis to flare up.

In suturing the mucoperiosteum, a basic principle of surgery, the establishment and maintenance of free and adequate drainage in septic surgical fields, is often violated. If, in finishing an alveolectomy, the technic as advocated by many is observed in the use of as many sutures as possible, to insure a smooth appearance of the gum tissue over the alveolar process, we have centered our attention on the mechanical features of the operation at the expense of an unpardonable violation of the basic surgical principle of adequate drainage, thereby needlessly subjecting the patient to grave hazards. The ecchymosis and excessive swelling that follow may be quite painful, unsightly and uncomfortable, not to mention the possible systemic results from septic absorption. In this connection, if the upper jaw is considered, it

might not be amiss to remember that the draining of septic material into the facial vein with its collaterals may, and all too often does, result in a fatal cavernous sinus thrombosis.

I am not a prosthodontist, but it is my understanding that among the basic physical principles requisite to the establishment of comfortable and functionally efficient dentures are: (1) a large and firm area upon which the base of the dentures may rest; (2) as great a transverse dimension from buccal wall to buccal wall as it is possible to maintain after the loss of teeth; (3) ridges of sufficient height, if possible, to leave between the opposing arches, when in proper occlusal relation, sufficient space only for the arranging of the artificial teeth together with their investing baseplate material directly about the summit of these ridges; (4) a transverse section of the ridge representing a modified letter "U"; that is, a crest of the ridge as broad as possible and gracefully though rather abruptly rounding at the lingual and again at the buccolabial margins; (5) an upper arch in direct opposition to the lower arch in the buccal regions and somewhat overhanging the lower arch in the labial region.

If the foregoing is true, alveolectomy, as advocated and practiced in the past and perhaps even today, is not only not conducive to the establishment of such physical oral conditions, but it is also diametrically opposed to them. This, no doubt, is a partial answer, at least, as to why high ranking prosthodontists oppose the practice.

If a large and firm area upon which the base of the denture may rest is the desirable condition, why reduce this area by cutting it away? If we need as great a transverse dimension from buccal wall to buccal wall as possible, why reduce this dimension by cutting away alveolar bone? If high ridges are beneficial, why reduce their height by cutting them away? If a transverse section of jaw should represent a modified letter "U," why slice away the buccal and labial tissue in such a way that a transverse section of the jaw represents a letter "V"? which, I am told, is one of the most difficult conditions encountered in denture construction.

If the arches, when in proper occlusal relationship, should directly oppose each other in the buccal regions with a slight overhanging of the upper arch in the labial region, why defeat this relationship by cutting away the arches? We must remember that cutting away the upper arch reduces its dimensions, while cutting away the lower arch increases its dimensions. With respect to the soft tissues of the mouth, we may note that the operator, having stripped the tissue loose from the bone to the region of the apices of the teeth, may, in his efforts to bring the lingual and the labiobuccal mucoperiosteum together in a neat suture line, disturb the normal position of the mucolabial and buccal folds, together with the labial frenum and muscle attachments, thus lessening the functional height of the ridges.

In view of the foregoing argument, the impression may have been gained that I am utterly opposed to alveolectomy and think it has no legitimate place in oral surgery, prosthodontia or elsewhere. For the major share of slaughter that has been done and that, perhaps, is still being done, that is true. There are many conditions wherein conservative and properly executed surgical procedure is of inestimable value to the patient and a distinct aid to the prosthodontist in solving some almost insuperable problems that confront him in denture construction.

In some cases, the borders of the ridge may project in such fashion as to produce

excessive undercuts, which may be reduced surgically. Bony protuberances in the median line of the palate and exostosis on the lingual aspect of the mandible may require surgical treatment. Sometimes, the osseous portion of the tuberosities is excessive and may require surgical reduction.

When one or two teeth, or, in fact, when several anterior teeth have been retained long after the loss of their neighbors, on removal of these teeth, a pronounced discrepancy may be found between the bone of the ridge immediately surrounding such teeth and that portion of the ridge from which the teeth have long been removed. Here again, surgical intervention is often indicated.

Excessive protrusion of the upper teeth, especially when accompanied by shortness of the upper lip, often justifies a conservative surgical operation for the purpose of bringing the ridges into more harmonious relationship to each other, and especially for the esthetic result which it is impossible for the prosthodontist to attain in these cases without the aid of surgery.

Fibrous bands passing from the cheek tissue to the crest of the ridge, or nearly so, may prove very troublesome to one wearing false dentures. These can ordinarily be cut back and sutured.

The labial or lingual frenum may have an attachment too near the crest of the ridge; a condition which can be corrected by merely cutting and suturing the frenums back.

Excessively large tuberosities, at least in the great majority of cases that have come to my attention, are large, not because of excessive osseous formation, but because of an excessive development or hyperplasia of dense fibrous connective tissue. The method of reducing such tuberosities as nearly to normal size and contour as possible consists, of course, in the removal of the fibrous tissue between the mucous membrane and the periosteal covering of the bone; then bringing the flaps of the mucous membrane into apposition, trimming away any excess and securing them with a suture or two.

Another condition similar to this, but much more extensive and also much more difficult to deal with from both a surgical and a prosthetic standpoint, is met with in those cases wherein there has been a more or less generalized dissolution of the alveolar bone, leaving excessive soft tissue that may fall into great folds on the labial and buccal aspects of the upper jaw with almost complete obliteration of the mucobuccal sulcus. These conditions, while difficult from the surgical angle, are not necessarily formidable. The surgical treatment consists of removing the excessive fibrous tissue between the covering of the bone and the mucous membrane, preserving all the mucous membrane possible and hitching it to the periosteum high up on the lateral wall of the arch, and thus creating a new mucolabial and mucobuccal sulcus.

When the intermaxillary space in the posterior region is not sufficient to allow room for artificial teeth, tissue may be removed from one or both arches, as the case may indicate.

After simple removal of teeth, in virtually all cases, the thin edges and margins of the alveolar crest bone present a very uneven surface with sharp projecting spinous processes and intervening depressions. This thin portion of the bone has, in itself, a very meager blood supply and, consequently, if the natural biologic forces are not interfered with, the projecting spines undergo resorption, and with the lapse of sufficient time, the alveolar crest will be smooth and rounding. Before the advent of surgical preparation, this was the procedure usually followed after the loss of teeth. Aside

from the fact that the patient in such circumstances was obliged to go without teeth for many months, a fundamental law of biology was, all during this time, permitted to operate to the detriment of the oral structures. I refer to the atrophy that always takes place in any tissue which is suddenly thrown out of functional activity. The alveolar process is an organ designed by nature for the support of the natural teeth. With the loss of the teeth, the function of this bone is ended, and the process of resorption or atrophy, if allowed to operate undisturbed, will gradually remove it. Therefore, intervention must arrest this atrophy as early as possible by restoring function to this organ. This may be done two or three weeks after the teeth are lost, by means of a temporary denture. The spinous processes above referred to are a great hindrance to wearing a temporary denture. They may be removed surgically at the time of extraction, but much more easily, more conservatively and with far greater safety to the patient if we let two weeks elapse from the time of extraction. Then, by means of surgical measures, the mouth will be made ready in a few more days for a permanent denture. I am well aware that much may be said against such a procedure, but I feel its merits may outweigh its disadvantages.

THE CENTER OF POPULATION OF DENTAL EDUCATION, 1870-1930

By WALTER CROSBY EELLS,* Stanford University, Calif.

THE center of population is defined by the United States Census Bureau as "the point upon which the United States would balance, if it were a rigid plane without weight and the population distributed thereon, each individual being assumed to have equal weight and to exert an influence on the central point proportional to his distance from the point." In other words, it is the center of gravity of the weighted plane or a two-dimensional average of the population.

The determination of this point at the regular decennial census intervals is the best method that has been devised by the Census Bureau to trace compactly the rate and direction of general movements of the population. The first official computation of this point was made under the direction of Francis A. Walker, superintendent of the ninth census, for publication in the first statistical atlas of the United States, published in 1874.[1] At that time, the position of the center of population was computed for each census year since 1790.

So convinced has the Census Bureau become of the value of this mode of sum-

*Professor of Education, Stanford University.

1. Walker, F. A. (compiler): Statistical Atlas of United States, Based on Results of Ninth Census, Washington, 1874: p. 5. For an earlier unofficial computation and other information regarding history of the center of population see Eells, W. C.: Center of Population—a Prophecy and Its Fulfilment, Scientific Month., 20:78-84 (Jan.) 1925.

TABLE 1.—LOCATION OF CENTERS OF POPULATION OF DENTAL EDUCATION, 1870-1930

Year	Latitude North		Longitude West		State	County	Distance from Important Cities or Towns
	Degrees	Minutes	Degrees	Minutes			
1870	40	30	76	58	Pennsylvania	Perry	17 miles north of Harrisburg
1880	40	49	78	36	Pennsylvania	Clearfield	13 miles ne of New Bloomfield (c.s.) 80 miles ne of Pittsburgh
1890	40	22	82	49	Ohio	Morrow	16 miles sw of Clearfield (c.s.) 28 miles north of Columbus
1900	40	05	85	34	Indiana	Madison	13 miles south of Mt. Gilead (c.s.) 13 miles sw of Muncie
1910	39	40	85	55	Indiana	Shelby	5 miles east of Anderson (c.s.) 14 miles se of Indianapolis
1920	40	12	87	48	Illinois	Vermillion	14 miles nw of Shelbyville (c.s.) 21 miles east of Urbana 10 miles west of Danville (c.s.)
1930	39	50	88	34	Illinois	Piatt	21 miles east of Decatur 14 miles south of Monticello (c.s.)

marizing population trends that, in later years, it has made much more extensive use of the same method. In 1910, the positions of the centers of population since 1880 for each state were computed. In 1920, the method was further extended to include centers of foreign-born population, of Negro population and of urban and rural population, and even to determine centers of agriculture, of manufacturing, of number of farms, of farm area, of improved acreage, of value of farm property and of the production of corn, wheat, oats and cotton.[2]

Why not then educational centers of population as well? A method that has proved so valuable in summarizing movements of general population should be equally valuable in summarizing the similar movements of the higher educational population—the student enrollment in the colleges, universities and professional schools of the United States.[3] The object of this paper is to report and discuss the results of computations that have been made by the author to determine the center of population of dental education for each census year from 1870 to 1930.

METHOD OF COMPUTATION

The data upon which the computations are based were taken from the official reports of the United States Office

2. Sloane, C. S. (compiler): Center of Population and Median Lines and Centers of Area, Agriculture, Manufactures and Cotton, (Fourteenth Census of the United States, 1920), Washington, 1923, pp. 12-41.

3. For four such studies, see W. C. Eells: Center of Population of Higher Education, School and Society, 24:339-344 (Sept. 11) 1926; Center of Population of Engineering Education, 1900-1930, J. Eng. Ed., 25:662-669 (June) 1935; Center of Population of Pharmaceutical Education, 1870-1930, J. Am. Pharm. Ass'n, 24:868-871 (Oct.) 1935; Center of Population of Legal Education, Am. Bar. Ass'n J., 22:61-62 (Jan.) 1936.

(formerly Bureau) of Education.[4] These statistics are not perfect, but they probably are as accurate and reliable as are available. The method used was the same as that of the Census Bureau, with the substitution of "states" (with their centers of population as computed by the census bureau) for "square degrees" as the unit of computation.

In making the computations for the location of the center of population it is necessary to assume that the center is at a certain point. Through this point a parallel and a meridian are drawn, crossing the entire country. . . . The product of the population of a given area by its distance from the assumed parallel is called a north or south moment, and the product of the population of the area by its distance from the assumed meridian is called an east or west moment. In calculating north and south moments the distances are measured in minutes of arc; in calculating east and west moments it is necessary to use miles on account of the unequal length of the degrees and minutes in different latitudes. The population of the country is grouped by square degrees—that is, by areas included between consecutive parallels and meridians—as they are convenient units with which to work.[2]

The number of students of dentistry involved for each census year is as follows: 1870, 237; 1880, 730; 1890, 2,696; 1900, 7,928; 1910, 6,439; 1920, 8,809; 1930, 8,162.

LOCATION OF CENTERS

The latitude and longitude and approximate location of the center of dental education for the seven different decennial periods since 1870 are shown in Table 1 and the map. The map also shows the location of the general center of population of the country for the same dates. The abbreviation "c.s." in Table 1 indicates that the town named is the county seat of the county in which the given center is located.

The outstanding fact shown is the very rapid shift westward of the center of dental education, a total of over 600 miles in six decades. This movement has carried this center from a point in central Pennsylvania, near Harrisburg, through Ohio and Indiana and well into Illinois. It has moved westward by varying distances from over 200 miles in a single decade to a minimum change of less than 20 miles. The general tend-

TABLE 2.—MOVEMENT OF CENTER OF POPULATION OF DENTAL EDUCATION, 1870-1930*

Year	From Point to Point in a Straight Line	Northward	Southward	Eastward	Westward
1880	88.2	19.4	....	....	86.0
1890	223.7	....	27.0	....	222.1
1900	146.9	....	16.8	....	145.9
1910	31.4	....	25.3	....	18.6
1920	104.8	31.8	....	....	99.9
1930	46.4	....	22.2	....	40.7
Total (Net)			40.1		613.2

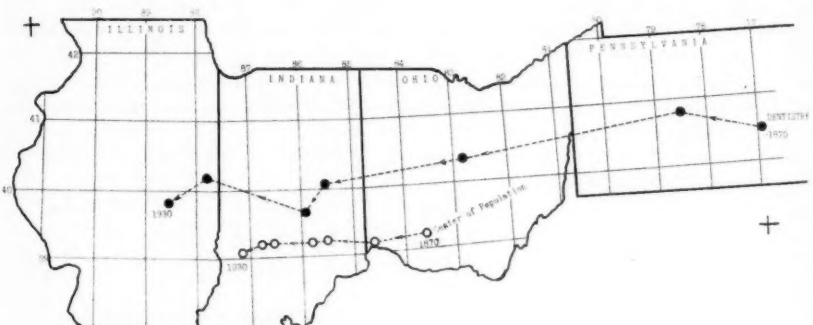
*In miles during the preceding decade.

4. Reports of the Commissioner of Education: 1870, p. 524; 1880, p. cliv; 1889-90, II, p. 1023; 1899-1900, II, p. 1972; 1910, II. p. 1034; Biennial Survey of Education, 1918-1920 (Bull., 1923, No. 29), p. 294; Biennial Survey of Education, 1928-1930 (Bull., 1931, No. 20), p. 349-350.

ency has also been southward, although the movement has not been marked, the position in 1930 being only 30 miles south of its location sixty years earlier. The movement of the center of dental education in miles each decade is summarized in Table 2.

Reference to the map shows that the center of population of dental education, which in 1870 was 352 miles east of the general center of population for the same year, in 1930 was 76 miles west of the general center in the same year. While the center of general population shifted westward 190 miles in six decades, the dental center jumped 613 miles, more than three times as far. "Westward the course of empire" has taken its way—but much more rapidly for dental students than for the general population. The north and south distance between the two centers, which was 90 miles in 1870, has decreased to 53 miles in 1930. Relative to the distribution of the general population, there is now a much greater emphasis on dental education in the West and the North than in the East and the South. The East has lost much of its earlier primacy in dental education.

By 1940, the dental center bids fair to be located somewhere in central Illinois, while the general center of population will probably scarcely reach the Eastern Illinois line. Such facts as these may furnish food for thought and speculation on the part of those responsible for the education of the dentists of the future.



Location and movement of centers of population of dental education and of general population, 1870-1930.

ANGIONEUROTIC EDEMA OF LOWER JAW: REPORT OF CASE

By J. LEO EPSTEIN, D.D.S., and A. EDWARD GINDEA, D.D.S., Brooklyn, N. Y.

ANGIONEUROTIC edema is, as the name implies, a neurovascular disturbance, usually of the lips, cheeks or eyelids. Menagh's recent analysis of 260 cases in which urticaria and angioneurotic edema were considered to be the same process, only involving different layers of the skin, places the condition among those to be given medical consideration. It is of the utmost importance that the dental surgeon be able to make a differential diagnosis in order to prevent indiscriminate extraction of teeth to alleviate the condition. The proper diagnosis will bring respect to the profession and appreciation from the patient.

The swelling is of varying size and may involve the entire lip, cheek or lower eyelid. George Blumer asserts that it may even involve the tongue, the fauces or other regions, thus producing alarming suffocating attacks. It is rarely accompanied by pronounced subjective symptoms. All the recorded fatalities have been due to sudden edema of the larynx.

The rapid onset, the absence of pain, the softness of the swelling and its disappearance within a few days make the recognition of the condition rather simple.

According to Menagh's report, food and other proteins were found to be the causative factors in 30 per cent of cases; biliary tract involvement in 45.8 per cent, and both of these in 11.2 per cent. The etiology was undetermined in 10 per cent of cases.

The treatment may consist of administration of Carlsbad salts, with daily exercise in the open air, tepid baths and regulation of the diet. Severe attacks are rapidly relieved, though, as a rule, only temporarily, by the use of a 1:1,000 solution of epinephrine-chloride, hypodermically.

The following case is presented partly because of the rarity of the condition in the lower jaw, its long duration and the fact that the transitory swelling simulates one of dental infection origin.

REPORT OF CASE

History.—J. H., aged 35, a bank employe, came into the office, Dec. 7, 1934, with the following history: He had attended a banquet the previous day and then drove home in his car and went to bed. On awakening the following morning, he discovered a swelling of the lower jaw, which was neither painful nor uncomfortable. As he had no pain intra-orally, he thought it best to go to a physician. The latter was of the opinion that the swelling was caused by an ailing tooth, and the patient was referred to his dentist.

Examination.—As the patient had had all needed dental work completed several months earlier, the condition of his mouth was well known. Roentgen-ray examination of several suspicious teeth revealed deep-seated amalgam fillings. Further roentgen examination was negative. There were no subjective symptoms and the only objective symptom was the flabby swelling

extending from one ramus of the jaw to the other. The condition suggested a large double chin.

Diagnosis.—On the basis of the history only, angioneurotic edema was diagnosed.

Treatment.—The patient was instructed to build up his resistance by proper diet, gastric lavage and plenty of rest and sleep. No other treatment was instituted. The swelling gradually decreased and on the sixth day had completely disappeared.

The comparatively long duration of the swelling in this case was also unusual, the condition generally lasting from three hours to three days.

481 Seventy-Third Street.

DENTISTRY AND TUBERCULOSIS

By LEONARD P. WAHL, D.D.S., Wausau, Wis.

ONE is surprised on surveying the files of dental publications to find how few articles appear under the caption "dentistry and tuberculosis." In formulating a paper on the subject, it is desirous to emphasize the close relationship of oral hygiene and masticating efficiency, two essential factors in the successful medical treatment of tuberculosis and its prevention.

In children, tuberculosis is usually of a more diffuse nature, involving, in a majority of cases, the glands, long bones and joints. In the adult, it is usually a local chronic disease of the lungs. As high as 95 per cent of adult tuberculosis is pulmonary, which may, in turn, be divided into the bacterial, the fusospirochetal and the mycotic abscess type. The two main sources of tuberculosis are human sputum and cow's milk; and the two main channels of entry are the respiratory and intestinal tracts, of which the mouth is the main gateway.

In the active case of tuberculosis wherein extensive degeneration of the lung tissue is taking place, hyperacidity due to faulty digestion is very noticeable and, with frequent coughing and regurgitation of food, establishes an environment of destructive influence on the teeth as well as the soft tissues of the mouth.

In the case on the road to recovery, or the so-called arrested case, when the process known as fibrosis or encapsulation of tubercles by connective tissue takes place, which may in turn go on to calcification with its demand for mineral salts, the teeth are predisposed to rapid decay, including a cervical type of cavity characteristic of tuberculous patients. To quote Lester Kahn:

> Cavities usually develop about the cervical margin of the crown; pain may or may not be present. The dentine is soft, leathery, and of a bright brownish color. The cavities resemble those seen in the mouths of pregnant women, except that they occur almost entirely about the cervical margins. The reason in both instances for these cavities is probably the same, namely a lack of calcium in the system.

The importance of milk, because of its high percentage of available calcium and phosphorus, supplemented by a dependable irradiated agent for vitamin D, as adjuncts to the diet, is apparent. Mention may here be made that the daily calcium requirement of 0.67 gm. for the normal adult is not sufficient for the tuberculous patient. Double the amount may be needed.

Tuberculosis cannot be contracted except by entrance of tubercle bacilli into the body. It has been recognized that a large percentage of the population of civilized countries has harbored them, and very few exposed to these organisms escape infection. There is a sharp distinction between tuberculous infection and tuberculous disease. If immunity is high, the infection may be held in check the entire lifetime.

As consultant dentist of the Mount View Sanatorium at Wausau, Wis., for the past sixteen years, I found my service to be mostly of a combat nature, owing to my coming in contact with the advanced case or the case under observation. From what has been said heretofore, dental attention in the treatment of tuberculosis must have two objectives: the first, the establishment and maintenance of masticating efficiency in its relation to nutrition, which, in the full meaning of the word, also includes sunlight, fresh air, rest and exercise; the second, the elimination of mouth sepsis to prevent secondary infection through the blood stream or from the inspiration or ingestion of infected particles of pus, tartar or food. The importance, therefore, of proper instruction as to the cleaning of the mouth by the patient, and frequent check-up as to technic to see that results are satisfactory, can well be appreciated, for all debilitating conditions pertaining to the mouth must be eliminated.

What has just been said relates to dental care in the active case. To concentrate on prevention should be our greatest objective. The combined efforts of the physician and the dentist are here made manifest in their contacts with the child patient; for whether or not the child becomes tuberculous depends on his hygienic care. Therefore, we must be cognizant of the fact that the greater responsibility toward prevention lies with the dental practitioner in his daily practice, in lieu of the work of the staff or consultant dentist. He must indeed fill the rôle of pedodontist and facial orthopedist. For, in his contact with the child patient, beginning at the age of 2½ years, he must instruct as to nutrition, mouth hygiene and the importance of frequent visits; discover the pernicious habits of the child, e.g., thumb sucking, lip, cheek or tongue biting; maintain the function of the so-called baby teeth for mastication, speech and breathing, during the time of the child's greatest development, to prevent their premature loss or overretention; keep in mind the importance of mechanical therapy during the transitional period, when necessary; and thus prevent those conditions conducive to malocclusion and facial deformities which hinder lung development, and other systemic sequelae. Last but not least, he must refer for proper medical attention those cases with lymphoid involvement; namely of the tonsils or adenoids. Only in carrying out preventive measures as just mentioned will his mission be fulfilled.

Surely, one acting with the highest degree of intelligence cannot ignore conditions in the mouth if it is the aim to permit the patient to mobilize all his defensive and recuperative resources, a cooperative measure paramount in the prevention and control of tuberculosis.

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C. N. JOHNSON, Editor

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Editorials

THE HARTMAN OBTUNDENT

In recent months, a fair sized furore has been created not only in the profession but also among the laity owing to the announcement by Dr. Leroy L. Hartman, of New York City, to the effect that he had discovered an obtundent that could be applied to the cavity of a tooth and render it impervious to pain in cavity preparation.

The manner of this announcement was most unfortunate. Instead of going to the profession and frankly stating what he had done, releasing through professional channels the nature of the agent that he was using, and at least to that extent taking the profession into his confidence, he made an announcement through the medium of the lay press to the effect that he had discovered such an agent, but not giving the slightest indication of what the agent was. There was only one possible implication in such a procedure, and that implication did not do credit to the best traditions of scientific investigation.

Immediately patients by the hundreds came to dental offices

with newspaper clippings in their hands, begging to have the new remedy used. When the dentists were obliged to say that they had not been informed as to the nature of the product, the reaction on the people, and the embarrassment of the profession, did not contribute either to good understanding or to the tenets of long established ethical procedure. We are not impugning motives: we are merely stating facts.

Finally, Dr. Hartman did what he should have done at the beginning: he published his formula. It was found to consist of thymol 1¼ parts, ethyl alcohol, 1 part, sulphuric ether, 2 parts. The gums around the tooth are to be protected against injury either by the rubber dam or other efficient means, and the product is to be applied to the cavtiy of the tooth with a pledget of cotton.

It is, of course, too short a time to judge of the actual efficacy of this treatment. We have Dr. Hartman's assurance after months of test that it will perform the service satisfactorily, and it would seem only natural for us to accept his findings at their face value. It is inconceivable that he could be altogether mistaken in view of the practical tests that he has made with it. Then others who have tried it find it effective, not, be it said, in 100 per cent of the cases. One hundred per cent is difficult of attainment in performing service of this character or in performing any service, and we need not be disheartened if there is an occasional untoward result. It is not likely that perfection of technic has yet been achieved. Probably in the near future, the method will be so improved and refined that it will be relieved of its last limitation, and we shall be able to obtund sensitive cavities without doubt and with little danger. Unquestionably, there is an element of danger to the pulp in certain instances, though if cases are selected with reason and the technic is performed carefully, we should not anticipate any very serious results.

But here is the rub. How many are there of the rank and file of the profession who can be induced to exercise proper care? This method does not lend itself to slipshod technic. In fact, if there was ever the possibility of harm in any widespread practice, it is in connection with this method. Our prediction is that unless in some manner we can call a halt on the promiscuous use

of this remedy, there will follow a sad tale of woe, the reaction of which will do infinitely more harm than good. We cannot escape the wish that Dr. Hartman had emphasized more strongly the possible misadventure that may follow his treatment. His apparent assumption of the fact that the last word has been said on the method will scarce pass muster as an adequate protection to the people, and we hereby caution our members to "make haste slowly" and employ every safeguard when they attempt the method.

But, with all that can legitimately be said in its favor, what shall we say of the acclaim that has gone forth from every quarter? It has been heralded as the greatest advance since the days of Horace Wells and Morton. Without wishing in the slightest degree to minimize the achievement of Dr. Hartman, it is absurd to claim that it is comparable to the discovery of anesthesia. The most unfortunate thing connected with the whole affair is the ballyhoo that has come out of it. Newspapers have published exaggerated statements about it, and the radio has been used in every possible species of buffoonery in its exploitation, greatly to the detriment of dentistry. Retail drug stores have been advertising and selling it over the counter, much to the general demoralization. This of course is not Dr. Hartman's fault: it is only a manifestation of the common tendency of the hour which seizes on every opportunity to tickle the palate of the people and capitalize the emotions good or bad of an avid public.

Now as to the concrete value and the breadth of beneficence of the new discovery. Let us keep our feet on the ground and ask a few questions. Let us acknowledge that the preparation of cavities constitutes one of the major dreads of the dental chair; it is not by any means the only dread, and the claim that this is a panacea for all of our ills is hardly justified. Patients complain of other things than the pain of cavity preparation. They complain of the noise of the dental drill, they complain of the vibration that contributes itself to the teeth and jaws in grinding teeth, they complain of the removal of deposits particularly if they are found under the margin of the gums. They complain of the fitting of bands. Above all things, they complain of the rubber

dam, and this complaint has reached such proportions that it has largely caused the elimination of the rubber dam from dental offices.

Can any one imagine that the use of this remedy, beneficent as it may be, will at once cause a path to be beaten from the outside world to the dental office? Hardly. Let us be grateful to Dr. Hartman for what he has done, and let us hope that the results will more and more lead to a general demand for dental service and eliminate much of the dread. Surely the psychology of the situation will aid in this after the widespread publicity that has been handed out to the people. But it is conceivable that there may be an aftermath.

Let us be a trifle more conservative in our judgment, and try to garner the good that there may be in it, and not place in jeopardy its undoubted benefit by extravagant and unjustified claims. Despite all of the demonstrations that have been made and all of our enthusiasm of the moment, it will require time and careful deliberation to judge of the ultimate results of this treatment, and while we cheerfully grant its possible benefits, we shall do well to recognize its inherent limitations, and not lose our mental balance sufficiently to lead to the possibility of ultimate disappointment and embarrassment.

LEGISLATIVE HISTORY OF THE DENTAL CORPS OF THE NAVY

Any new development in the status of the Dental Corps of the Navy or the Army is always of interest to the profession. Increase in rank is a notable achievement in either branch of the service.

The highlights in the Dental Corps of the Navy are as follows: In 1912, authorization was made for the appointment of "not more than thirty assistant dental surgeons" with rank of lieutenant (junior grade). In 1916, an act authorized the President to appoint and commission dental surgeons in the Navy at the rate of one for each 1,000 of the authorized strength of the Navy and Marine Corps. Also this Act made provision for the one

grade of dental surgeon with the three ranks up to and including lieutenant commander. The Act of 1920 authorized transfer of temporary and reserve dental officers to the regular Navy. The Act of 1926 provided that all staff officers be granted promotions equal to that of line officers and further provided that officers of the Dental Corps be eligible for promotion up to and including the rank of captain in the Navy. In July, 1935, a great advance was made in the passage of an Act which permitted appointment of one dental officer for each 500 persons in the Navy and Marine Corps.

A new distinction has just been given to the Dental Corps. Recently, the Secretary of the Navy appointed a board of flag officers of the line to select not more than seven of the twelve senior commanders of the Dental Corps of the Navy for promotion to the rank of captain. The board was composed of Rear Admiral Walton R. Sexton, U. S. Navy, president, and Rear Admirals Adolphus E. Watson, Joseph R. Defrees, Ernest J. King, Manley H. Simons and William S. Pye, U. S. Navy, members. Lieut. Com. Clemens V. Rault, Dental Corps, U. S. Navy, was recorder. January 24, the President of the United States approved the board's findings and announcement has been made that the following were selected for promotion:

Commander Harry Edward Harvey (DC), U. S. Navy,
Commander Eugene Hunter Tennent (DC), U. S. Navy,
Commander Joseph Aloysius Mahoney (DC), U. S. Navy,
Commander Lucian Cocke Williams (DC), U. S. Navy,
Commander Paul Gardiner White (DC), U. S. Navy,
Commander Cornelius Henry Mack (DC), U. S. Navy,
Commander John Ronald Barber (DC), U. S. Navy.

It is interesting to note that the rank of captain in the Navy is equivalent to that of colonel in the Army.

We tender our congratulations to the members of the Dental Corps in the Navy, and particularly to the men who have recently been appointed. Every advance of this character tends to bring added prestige to the profession.

THE MAIL ORDER RACKET

At various times, the dental profession and the public are victimized by mail order schemes promoted through the medium of advertisements in papers and magazines. One of the most notorious impositions on the people relates to the nefarious scheme of advertising artificial dentures by mail from impressions made by the patient under written instruction given by the advertiser.

How perfectly futile such a procedure is need not be enlarged on here, and it is inconceivable that such schemes can ever gain any ascendancy. But the gullibility of the public is beyond comprehension, and the ubiquitous advertisers do the rest. Some of our lay publications lend themselves to the most degrading influences through venal advertising solely for the purpose of making money, and, in some instances, certain periodicals that assume an air of respectability yield to the temptation to exploit the public through the greed of gain. Not only that, but, when taken to task by members of the profession, they attempt to justify their practices by the most specious and flimsy argument.

A rural publication with an avowed circulation of 2,000,000, for instance, persists in running an advertisement for mail order dentures, and boldly contends that, after investigation, they are convinced that the advertiser is conducting a legitimate enterprise. The absurdity of such a claim is too apparent to be discussed, yet this publication goes on filling its coffers with the ill-gotten gain of such advertising.

The only recourse is to enlist the aid of the government in seeking a cease and desist order against such practices. Eternal vigilance is the price of protecting a large element of the community against their own foolish propensities, and the time seems a long way in the distance when an aroused public conscience can ever be trusted to cope with the question of preventing fraud and injury to the public. People simply will insist on being fooled, and the spectacle is sufficiently pathetic.

We are indebted to Homer C. Brown for information on this particular racket, and the probabilities are that this is only one of a score of similar schemes for fleecing the public. Eventually,

this racket will be sufficiently exposed to be null and void. The essential folly of mail order dentures must, of its own weight, bring it into disrepute, but meanwhile many people will be victimized, and much money will be squandered needlessly.

Obituary

WALLACE SECCOMBE, L.D.S., D.D.S.
(1878-1936)

Wallace Seccombe was born in Toronto, April 3, 1878. He was graduated from the School of Dentistry of the Royal College of Dental Surgeons of Ontario in 1900, and commenced private dental practice in Toronto. He was the first dental officer ever appointed by the Toronto Board of Health to take charge of the dental service in public schools.

From 1908 to 1912, he served as representative of the dentists of Toronto on the Board of Directors of the Royal College of Dental Surgeons. In 1912, he was appointed superintendent of the college. He was for several years professor of dental economics, librarian and curator of the museum. He served as professor of preventive dentistry from 1916 until his death, January 16. This department in the college was inaugurated by him.

When the office of superintendent of the college was abolished in 1923, Dr. Seccombe was appointed dean. The School of Dentistry of the Royal College of Dental Surgeons of Ontario, which had been affiliated with the University of Toronto since 1888, became an integral part of the University in 1925, and Dr. Seccombe was appointed dean of the Faculty of Dentistry.

Dean Seccombe was the only Canadian ever elected president of the American Association of Dental Schools. It was considered a high honor when he was appointed chairman of a committee of that association to make a survey of the dental curriculums in the United States and Canada. After a 400 page report of this committee was published last spring, it proceeded with a study of postgraduate work and the training of dental teachers. This survey was made possible by a grant from the Carnegie Corporation of New York amounting to $45,000.

Throughout his career in the profession of dentistry, Dr. Seccombe has been a strong influence in raising the status of the profession, and has been instrumental in obtaining provincial legislation regarding dentistry.

He has whole-heartedly supported the development of research, and it was largely through his initiative that the degrees of bachelor of science in dentistry and master of science in dentistry were established by the University of Toronto.

His death came quite unexpectedly. He had been suffering from anemia since the summer and did not respond to the usual treatment. However, while less energetic than formerly, he had been endeavoring to carry on his duties at the Faculty of Dentistry, and was in his office the day before his death.

Surviving are his wife, the former Margaret Elizabeth McKendry; four children,

Mack, William Wallace, Elizabeth Jane and Margaret Patricia; a sister, Mrs. Alex McTaggart of Montreal, and a brother, William Seccombe, of Vancouver.

Dr. Seccombe for years conducted the Men's Bible Class of Timothy Eaton Memorial Church. He was a member of the Arts and Letters Club, the Thornhill Golf and Country Club and the Granite Club, as well as the University Masonic Lodge. He founded and edited for twenty-five years the dental journal, "Oral Health," de-

WALLACE SECCOMBE, L.D.S., D.D.S. (1878-1936)

voted to the interests and advancement of dental science. His broad vision and interest in world affairs led to the founding in 1931 of "Canadian Comment," a national magazine of current events.

Dr. Cody, president of the university, paid this tribute to Dean Seccombe: "He was a wise, sane and progressive administrator. The Dental Faculty of which Dean Seccombe has been the head since its union with the university, has functioned admirably and without friction under his leadership."

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Guest—Every one who enters your office is your guest. Treat him accordingly.—*C. C. Norris, Oshkosh, Wis.*

Malleting—Have assistant rotate wedge shape instrument in interproximal space when malleting mesioclusal inlay into place.—*C. C. Norris, Oshkosh, Wis.*

Use of Tissues After Extractions—A neatly folded paper napkin will be greatly appreciated by your patient after extractions, as blood is difficult to remove from a linen handkerchief.—*Raymond Martin Curtner, Ukiah, Calif.*

Use of Tissues in the Office—A paper napkin placed upon the bracket table will be found useful for wiping instruments during sealing, trimming wax and stopping, and thus the bracket stand will be kept neat. Also, when these paper tissues are conveniently placed in the dressing room, woman patients will find other uses for them. —*Raymond M. Curtner, Ukiah, Calif.*

Patience with "Cranks"—In ignoring the patient's complaints and too often attributing them to neurasthenia, one runs the risk of losing the patient's confidence. There are a few neurasthenics and some "cranks," but not all patients are in this class; therefore, all patients should be treated sympathetically, attentively, patiently, humanely.—*James L. Zemsky, 147 Fourth Ave., New York City.*

Carcinoma Mistaken for Pyorrhea—Carcinoma of the jaws may not present a very characteristic picture of malignancy at the beginning, and such cases have been mistaken by the dentist for pyorrhea, and treated as such, to the great distress and often calamity of the patient, and final loss of courage and self-possession. All destructive mouth lesions should be treated with suspicion and much concern.—*James L. Zemsky, 147 Fourth Ave., New York City.*

Stress Relieving of Fillings—Favoring the weaker at the expense of the stronger is important and justifiable. The lives of many good fillings are shortened by overstress. Transferring from one's right pocket to the left is not stealing. To steal the tip of one tooth in favor of another is honest. A mandrel carrying one or two coarse sandpaper disks coated with cocoa butter or vaseline cuts rapidly. The paper is shock absorbing and the lubricant is soothing and cooling, the impression holding of polishing rather than grinding. A mounted stone, more severe, often meets objection from the patient. Stress relieved fillings are better because they last longer.—*Herbert Ely Williams, Red Bank, N. J.*

Juvenile Confidence—When removal of space retaining temporary teeth becomes necessary, children often absorb unfavorable impressions of the dentist and his office. Take a roentgenogram of another area, requesting the little patient to write you a letter a week later as to how the healing has progressed. Answer the letter, enclosing the film and explaining why the extraction was necessary and painful. One letter was received saying, "I had a lot of pain for four days, but I want to thank you so much for being so awfully nice to me." Don't try to take that patient away from her dentist; it can't be done.—*Herbert Ely Williams, Red Bank, N. J.*

Anesthesia in Trismus—Some years ago, having to make an injection in a case of trismus as a result of partial eruption of a lower third molar, I chanced on a method which, lately, I have come to use in all mandibular (conductive anesthesia) injections. I palpated the junction point of the internal and external oblique ridges and passed the needle into the tissues about an inch or slightly more and slowly injected, continuing as I withdrew. The result: complete anesthesia. As regards the trismus, the jaws opened as is their way under such circumstances. Recently, it occurred to me that I might well try it again, and invariably the result has been the same, with the added comfort of "no guesswork." Besides, there is no resistance to the passing of the needle into the tissues, as the usual muscular tautness is missing. —*C. B. Mandelbaum, New York City.*

Plaster Bowl Demonstration—The effects of thermal changes as applied to dentures have been generally ignored. Vulcanite rubber has an extremely low thermal conductivity as demonstrated with a rubber plaster bowl. When boiling water is poured into a cold plaster bowl, it may be held within the palm of the hand indefinitely without discomfort. The thicker base of the bowl does become as warm as the thinner portion; which demonstrates that the thicker the vulcanite denture, the lower the thermal conductivity. Metal dentures which transmit temperature more readily would seem more in keeping with the natural oral environment than other denture material. When it is desirable to stress the advisability of certain metals for favorable cases, the plaster bowl is a simple, convincing and practicable means of demonstration and one which a patient can understand. It is also a "word saver," for the busy dentist himself.—*Herbert Ely Williams, Red Bank, N. J.*

Retaking—The patient has been referred for a full mouth roentgen-ray examination. He is waiting, and the dentist finds that one or two films must be taken. He fumbles with the films, trying to find out whether the exposure was on the right or the left side. A quick method of determining this fact is the following: In mounting the films prior to insertion in the developer, place the x-ray holder so that the hook is parallel with the floor and clip the films so that the shiny side is up. (The shiny side is obscured after the film is wet.) After the films are fixed and washed, examine under the light, and if a film is defective, the dentist can immediately tell which side it presents because the relative positions of the hook and shiny side of the film are known, and the position which the film would assume when mounted is being reproduced. If the radiatized film is used, the convex side of the button is placed parallel with the hook.—*Bernard P. Morgenstern, New York City.*

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the Rules of the Council on Dental Therapeutics of the American Dental Association. The admission of an article does not imply a recommendation. A copy of the rules which govern the Council in the consideration of articles will be sent on request.

SAMUEL M. GORDON, *Secretary.*

Anesthetics—Local*

Reliance Tablets Procaine Hydrochloride (0.02 gm.) with Epinephrine Bitartrate (0.09 mg.) and Sodium Chloride (0.007 gm.)

Reliance Tablets Procaine Hydrochloride (0.02 gm.) with Epinephrine Bitartrate (0.06 mg.) and Sodium Chloride (0.007 gm.)

Reliance Tablets Procaine Hydrochloride (0.02 gm.) with Epinephrine Bitartrate (0.036 mg.) and Sodium Chloride (0.007 gm.)

Manufactured by Reliance Dental Manufacturing Co., Chicago, Ill. No U. S. Patents or Trademark.

*A.D.A., 1935, p. 34.

CALCIUM CARBONATE*

Snow Top Calcium Carbonate Precipitated Extra Heavy, Standard Drug and Super Light.—Snow Top Calcium Carbonate Precipitated complies with U.S.P. X (p. 87). They are used in the manufacture of dentifrices.

Manufactured by the Industrial Chemical Sales Company, Inc., New York City and Covington, Va. No U. S. patent. U. S. Trade Mark 282,919.

PHYSICAL PROPERTIES:

Density:

Extra heavy	2.72 gm./c.c.
Standard drug	2.78 gm./c.c.
Super light	2.76 gm./c.c.

PARTICLE SIZE: The particle size is determined by suspending the material in castor oil in the proportion of 1 gm. of material to 1000 c.c. of oil (1 mg. to 1 c.c.), then counting the particles in a counting chamber. The total number of particles as well as the number falling in each group were counted. The following distribution is said to be typical:

Diameter (μ)		1	1-5	5-10	10
% of weight:	Extra heavy	3.9	91.0	4.7	0.4
	Standard drug	40.0	60.0	....	....
	Super light	60.0	40.0	....	....

ABRASIVENESS: The abrasiveness of Snow Top Calcium Carbonate Precipitated is determined by rotating a block of antimony (250 Bierbaum units, 3 Moh's Scale [A.D.R. 1935, p. 76]) against a slurry of chalk and water under a weight of 63 gm. for 6,480 revolutions on a test machine (details filed with the Council). The following weight losses occur:

Extra heavy	4.5 mg.
Standard drug	4.5 mg.
Super light	4.6 mg.

*A.D.R. 1935, p. 72.

SHOTGUN VITAMIN THERAPY

Recently, the Council on Pharmacy and Chemistry of the American Medical Association has considered the practice of marketing combinations of highly potent vitamin substances. Some of the conditions discussed by the council are of immediate interest to the dental profession. It is shown below that the admixture of orange juice and cod liver oil lessens the activity of the orange juice in the prevention of scurvy. Since the effect of both of these vitamins are of immediate interest to the dental profession, it has been felt desirable by the Council on Dental Therapeutics to reprint the report of the Council on Pharmacy and Chemistry with the endorsement of the former.

SAMUEL M. GORDON, *Secretary.*

The American people have been made "vitamin-conscious." Clever advertising emphasis on the infinitesimal and not easily detectable amounts in which the vitamins occur in ordinary foodstuffs and further play on the startling results that appear in animals deprived of even these small amounts have stimulated a popular romance and mystery.

This popularization of the comparatively recently acquired and constantly growing knowledge of the various vitamins has resulted in many errors and misconceptions largely to the benefit of the unscrupulous, but sometimes also of the well-intentioned manufacturers of products offered to the public. Among these misconceptions are the ideas that everybody needs to take supplements of all the vitamins all the time and that it is both therapeutically and chemically advisable to combine all or some of the vitamins, perhaps with some mineral or minerals, in one preparation. It has apparently been forgotten that no necessity has been found for administering preparations containing complex combinations for effective maintenance of health when a well-balanced diet is taken. Clinically recognizable multiple vitamin deficiency diseases are certainly rare in this country.

It has been stated that about thirty-seven elements or substances are necessary in a complete diet; among these are vitamins. That they are grouped together under this name does not indicate that they are closely related chemically. For instance, vitamin C is closely related to the sugars, while vitamin D is one of the sterols. From a physiologic standpoint it is just as irrational to prescribe a mixture of a number of the vitamins as a combination consisting of cystine, iodine, iron, and linoleic acid or any other combination of dietary essentials.

At the present time there seems to be no more logical basis for including all or a number of vitamins in one preparation than there is for combining a number of the other known dietary essentials in any one pharmaceutical product. The functions of the vitamins are as diverse and independent as their chemical constitution would indicate.

It is not perhaps surprising that efforts have been made to supplant the use of the various natural vitamin-containing substances by preparations of highly potent concentrates, either singly or in combination, and also by their combination with minerals in mixtures, in tablets and in capsules. Having prepared such combinations, it is of course natural that manufacturers propagandize information regarding their need extensively to the medical profession through scientific journals and also to the lay world through the radio, the press and the mails. At first sight the combinations of vitamins offer the obvious advantage of simplicity of administration from the point of view of both the patient and the physician. From the standpoint of the manufacturing pharmacists, they have the added advantage of ease of preparation, wide demand and ready marketability.

The fact that the vitamins are chemically active substances essential, in all probability, for maintaining normal cell metabolism makes it necessary here to consider the bearing of the pharmacologic incompatibility of mixtures of drugs and their possible antagonistic action in the body. Sufficient attention perhaps has not been paid to the physiologic action of potent vitamin concentrates when they are combined and taken by man into the body in fixed amounts; that is, as to whether the action is the same as when the vitamins in their natural state are supplied to the organism, or whether it is different.

The voluminous literature reveals little information dealing directly with the subject of polypharmaceutic mixtures of vitamins. A few studies in which a combination of physiologically active concentrates has been administered indicate significant interaction between the vitamins and fail to show the anticipated beneficial results. There should be borne in mind the paucity of information in this field, and firms marketing such products should be reminded that the burden of proof for claims made for such mixtures rests entirely on the firms making them.

The question arises as to whether there may be an enhancing action of one vitamin concentrate when combined with another. There is practically no reference in the literature to such a phenomenon when the absence of a multiple deficiency disease is excluded critically. The impression is gained that, at best, the action of combined concentrates of vitamins would be the sum of the effects of each vitamin constituent. Commonly, the potency used of each concentrate for prophylaxis is that which has been adopted as the protective amount; which, it should be remembered, has been determined according to its effect in different species of animals. The argument that certain vitamins exist together in nature is no guaranty that the action to be expected from these is brought about by administration of potent concentrates in which they are combined by various processes. When a specific vitamin in its natural state is administered, utilization in the normal human body is adjusted according to a nicely regulated mechanism; but when the vitamins are extracted or concentrated and given together in different mixtures in tablets and in capsules, it may be questioned whether or not there is interference or enhancement of the specific effect of the different vitamin concentrates so combined. So far as can be found there is in the literature very little reference to that question.

Even if no harm results, it should not be forgotten that the giving of combined vitamin concentrates unnecessarily often proves to be an economic wastage. This is so especially in the use of such combinations in the treatment of a specific deficiency disease, when the better practice of medicine indicates the therapeutic use of the specific or of a single vitamin in adequate dosage without necessarily requiring an increase (or decrease) in dosage of the other vitamins. There is no direct evidence that vitamins have a supplemental effect on one another when in combination. It should be pointed out here that the administration of complex vitamin preparations is open to all the objections that may be urged against the routine use of mixtures containing ingredients in fixed proportions.

It is well known that the commonly used vitamins are peculiarly susceptible to destructive effects when they are removed from their natural chemical environment. It does not therefore seem necessary to discuss in any detail the antagonistic action of the different factors in the destruction of each individual vitamin. Yet there are certain pertinent facts that may be of interest.

For instance, it has been shown that there is impairment in potencies of vitamins A and E when they are subjected to aeration, especially in the presence of heat. As early as 1920, Hopkins showed that vitamin A in butter, although resistant to heat alone, is rapidly destroyed by heat plus aeration. Later, Mattill discovered that not only oxidation but rancidity developing in sources of vitamins A and E destroyed their specific action. Another procedure that decreases the availability and hence the effectiveness of vitamins A and E is admixture of mineral oil. Presumably, this results from the solvent action of the oil, so that the vitamins escape absorption. The ease with which vitamin

C potency is impaired by heat and by varying the p_H of the solution in which it is contained has been repeatedly observed and is of practical significance in the canning of fruits and vegetables. The catalytic action of copper in such processing is well established as responsible for destruction of vitamin C.

Further evidences of the lessening of the potency of vitamin concentrates in mixtures are found in their combination with minerals. The references consulted are those concerned chiefly with iron, but there is some reason to suppose that iodine may destroy the potency of vitamins. McCollum was the first to note the destructive effect on vitamin A of diets containing iron salts, when fed to white rats. Subsequently, Jones showed that ferrous sulphate could so effectively destroy vitamin A that xerophthalmia might be produced (in rats). Mattill and also Waddell and Steenbock reported that vitamin E could be destroyed by the addition of iron salt to a stock ration.

It appears, therefore, that, within recent years, the contributing causes for the destruction or prevention of the characteristic effects of vitamins have received much attention, with the result that special efforts have been made in manufacturing such preparations to make them effective. In the case of some preparations this has been found possible. The use of antioxidants, the regulation of the p_H and of the thermal conditions, and various other measures have been designed to aid in preventing the destructive action. It may be said that vitamin concentrates of vitamins A and D can be manufactured so that, in the finished product the concentrate will meet the requirements of the recent U.S.P. X-revised dosages for these vitamins. But it is very difficult to find any evidence whatever that a deterioration of the potency may not take place on standing or from the interaction of highly potent concentrates of *other* vitamins when combined. This holds true for combinations of vitamin concentrates in the form of capsules, in tablets and in liquid or oily mixtures, and of vitamin concentrates with minerals. Tablets and concentrates containing vitamins A and D have been quite stable for the period of years in which it has been possible to test them by biologic assay.

There is experimental evidence supporting the view that an antagonistic reaction exists between certain of the vitamins when given in combination. Certain investigators have advanced the belief that large amounts of vitamin A concentrate may be responsible for a disturbing effect on vitamin B. As early as 1922, it was reported by Mouriquand and Michel that, in a series of experiments on interference with the curative action of vitamin C in the treatment of scurvy, they attributed the interference to the presence of vitamin A.

The Council's referee recently reviewed a considerable number of cases of scurvy occurring in an eastern hospital where there was practically an epidemic of scurvy. Nearly every year, from forty to sixty children with scurvy are seen. Reviewing the number of cases in his service in the last ten years, the referee found something like 300 or 400. When asked, some of the mothers stated that their children had been fed orange juice. When asked how the orange juice was given, they stated that it had been mixed with cod liver oil preparations.

There have been numerous investigations on the toxicity of vitamin D concentrates in large quantities. A few of these are the investigations of Kreitmar and Moll; Pfannenstiel; Light, Miller and Frey, and Klein. In such experiments the addition of extra amounts of vitamin B complex has been shown to diminish the toxicity of excessive vitamin D dosage, according to the work of Harris and Moore.

These are some of the better known examples of the interrelationship of the total quantities of vitamins to one another. It certainly would seem that one vitamin, in varying proportions, might render ineffective quantities of another vitamin that normally are adequate. Further investigation seems necessary before one is able to say just which vitamin concentrates may be safely mixed without impairment of the activity of the ingredients, how much of each is necessary in such mixtures, and what deleterious in-

fluences may result from the presence in such mixtures of various oils, oxidizing agents, mineral salts, and so on.

From this relatively short review concerning the combination of vitamin concentrates for prophylaxis and therapeutic effects, certain points stand out:

It has been brought out that there has been practically no experimental or clinical evidence which tends to show that vitamin concentrates are enhanced or have any supplementary action when given in combination, either for prophylaxis or for therapeusis. The best that may be expected from any given combination is that each specific vitamin will produce its maximum effect independently of the other ingredients of the mixture.

It has also been shown that certain inorganic, organic and even physical agents may destroy the potency of vitamins with which they come in contact. For example, vitamin A and E, especially the former, are destroyed by contact with oxygen, especially during heating, by mixture with mineral salts like iron, and with certain organic fats. Even food materials and certain inert substances may interfere with the effect or absorption of vitamins. For example, lard and other unsaturated food fats and mineral oil so affect vitamin A. This makes it important to study further the influence of other ingredients in synthetic preparations of vitamins where they have been removed from the protective influences present in their natural sources, and to investigate the results of administering vitamin concentrates in close relation to food intake. The presence of pathologic states may also influence the absorption of vitamins given even in ordinarily adequate amounts; that is, abnormalities in the small intestine or operative shunts may interfere with the absorption of vitamins A, D and B; biliary disease may likewise interfere with vitamin A utilization, and gastric anacidity may prevent the proper utilization of vitamins C and B.

It has been pointed out that there is ever-increasing evidence that a delicate interrelationship exists between vitamins, because of either a physiologic relationship or actual incompatibilities of various vitamins; that the administration in combination of concentrates of vitamins, each of which is active independently, may so alter the effectiveness of each as to render it inadequate or to necessitate an increase in its dosage. For example, vitamin B has been reported to be rendered less effective when given with large amounts of vitamin A. In order to offset that, it seems that much larger amounts of vitamin B complex are necessary in such mixtures. In the case of vitamin C, large quantities of cod liver oil may render it ineffective in the prevention and cure of scurvy. There is not even a sound empirical basis for fixing the relative ratios of the various vitamin ingredients of mixtures.

The attempt to supply a sufficient amount of a single vitamin concentrate specifically indicated, when a mixture of vitamins is prescribed, may result in an excess of the remaining active agents. The possibility of harm from such excess must be kept in mind; even when no harm is done, such a combination may constitute an economic waste.

From this review, the Council concluded that there is a wide field for the study of this question: as to the incompatibilities, the impairment of vitamins when they are prepared in concentrate and prepared in mixtures and as to the manner in which they are administered to the patient.

One of the cardinal principles of the Council has always been that the burden of proof lies with the manufacturer. From the foregoing brief review it is discerned easily that the status of mixed vitamin therapy is on insecure grounds. The Council therefore will not accept mixtures containing vitamin concentrates until the manufacturers are able to present adequate evidence of their rationality. This does not refer, however, to concentrates of vitamin A and D, which occur combined in nature as such in cod liver oil; nor does it apply to any combinations of vitamins that may occur in nature in therapeutic amounts.

BUREAU OF PUBLIC RELATIONS

COMMUNITY HEALTH PROGRAM

By EMORY W. MORRIS, D.D.S., Battle Creek, Mich.

A COMMUNITY participation program in health education, which is sponsored by the W. K. Kellogg Foundation, is being carried out in five counties in southwestern Michigan.

Although a community is a component part of a nation, in many respects it is a complete unit. If a community is to adjust itself to this changing world, it must learn for itself. Education of the community cannot be accomplished by one, two or three agencies or influences. The dentist, the physician, the public health worker, the teacher, all official and voluntary agencies must together work out a health program for the community. Each must contribute advice and help. Each must use tolerance toward other groups. Each must sacrifice some past glory and present complacency. Methods and fields of operation will vary, but common objectives must be agreed on if progress is to be made.

The public is demanding more and more information in regard to health matters and is beginning to have an appreciation of the importance of dentistry in an adequate health program. The pedagogists now consider health education as a possible part of the school curriculum. We are grasping the importance of preventive dentistry. The idea is beginning to crystallize in the public's mind. Future health progress will require less crusading and more practical assistance to individuals and to communities in the form of organization and education.

When first we learned that education was to be of primary importance, we made the usual mistake of confusing education with schooling. In the majority of dental health programs, we have leaned heavily on the schools and formal methods of instruction to bring about desired results. While the importance of the school program cannot be overemphasized, we are gradually learning that education is not limited to the hours spent in school. We have learned that one's so-called education is simply his interpretation of the automatic summation of his experiences.

Thus, we find that any child's given attitude toward going to the dentist depends not alone on what he learns from the teacher or the text, but also on the attitude of his mother, his father, other children, the boy scout leader, the physician, the Sunday school teacher, the newspaper and the motion picture, set off against each other with varying weights of influence according to the value the child unconsciously places on the source.

It seems, then, that the problem of health education for a community will eventually boil down to the organization of these educational forces so that they will be consistent and the major emphasis will be placed where it logically belongs. Quite obviously, this means that the dentist, the physician and other professional people directly concerned with the health

of children must become educators of high caliber in their respective fields. A degree of cooperation and unity of purpose is called for that is possibly beyond our present capacity and comprehension.

The emphasis in both dentistry and medicine, of course, must be placed on prevention and not on cure. Curative dentistry has not needed an educational technic; preventive dentistry demands one. It requires little educational technic to get a child with a badly abscessed aching tooth to the dentist's office, but it is too late to start immunizing against the disease when the symptoms are discovered.

The dentist himself must do a great deal of this educating simply and directly, and with profit not only to the patient, but also to himself. If left to the parent, the choice would be obvious. What parent would not prefer to learn directly about the child's dental condition from his own dentist rather than to receive an impersonal interpretation? The public must be educated along preventive lines, with the idea that they will see the health and economic advantages of such a program, and demand this type of service. This demand cannot be created by the profession alone, but must be the result of the sum total of the various forces that can be utilized to educate the patients. The involving forces will vary in intensity and direction, acting upon the individual. Sometimes, they supplement one another, and sometimes they conflict. All professions are forces in health education now undeveloped or negative. They are educational in the sense of contributing to the patient's experience. Every patient who makes a trip to the dentist's office is being educated. It is the profession's responsibility to make the most of this opportunity. This, then, is a challenge to the profession. A simple suggestion by the dentist who has the confidence of the family, "Of course, John will have his teeth taken care of at regular intervals," is worth more than any amount of education direct or indirect.

The dental societies in the five counties in this area are making a serious attempt to cooperate with the official and voluntary agencies in their communities in an effort to better educate the whole community in regard to mouth health. The private practitioner of dentistry has had little opportunity to cooperate with the official health agencies in his community. This is probably due to lack of interest on the part of both the dentist and the health officials. Our health departments have been busy with vaccination and immunization programs and communicable disease control, to say nothing of their activities in the field of sanitary engineering. The majority of dentists have been confining their efforts to their office practice and have taken little interest in the health activities in their community. For the past several years, we have been coming out of our shells, realizing our responsibilities, and we find that we are living in an age that requires more cooperation and less competition.

Each of these counties, which are typically rural, has a county health department under the direction of a medical health director. He acts as executive coordinator and administrator, as the executive secretary of the medical and dental societies, but does not practice medicine either preventive or curative. He thus avoids the difficulties based on the competition usually existing between private physicians and health departments. Faced with the same responsibilities, he must achieve essentially the same results, but he must arrange to do this through the cooperation of the physicians, the dentists and all the other interested groups in his county. Some such a unit is essential for a cooperative program of this

type, for obviously we must have some agency that will coordinate all groups interested in the health of the community and act as the administrative agency for these groups.

We have said to the county dental society that if the members will devote some time, energy and thought to seeing what they can do toward creating a demand on the part of the public for better health for the child and will make an effort to prepare themselves to meet this demand, we will supply the wherewithall until such time as the project will take care of itself; always with the understanding that when the demand is created and supplied, distribution will be dealt with in the light of its own problems and in light of the methods evolved in the meantime to bring about these conditions.

The first step in this program, as far as the dentist is concerned, was the organization of a dental examination program for all the school children in the county, not with the idea of determining the dental conditions in the county, but to serve as an educational project for the dentist, the teacher, the physician and all other interested groups, with two objectives in mind: (1) its value to the child and community and (2) the education of professional groups.

The examination is used as the basis of a learning experience for the child and brings both the child and parent in direct contact with the dentist. For several weeks preceding the examination, the teacher builds up a project about mouth health, so, at the time the dentist makes his appearance, the child understands a great many facts about his mouth and his teeth and their relation to general health.

The teacher is prepared for this new educational work first by attending a health education seminar, which is held at a large camp for three days. Here, she meets the other teachers from her county, and the plans for all phases of the program for the coming year are discussed and demonstrated. Educational material is given to her. She receives help in planning units of work around the dental examination, physical examination, remedial programs in both medicine and dentistry and the value of immunization and vaccination, and all other related subjects that have a bearing on the health of the child.

Secondly, she is assisted throughout the year by a group of family health counselors who are on the staff of the health department. These counselors are trained in the field of public health nursing, education, mental hygiene, etc. All are required to have their degree in education in addition to a nurse's training. They assist the teacher in preparing the educational material for the child, and serve as a go-between for health department, physician, dentist and teacher.

The opportunities this examination affords the dentist are numerous. Each dentist takes charge of the work in the area from which he naturally receives the majority of his patients. At the time of the examination, he takes over the rôle of teacher, imparting as much knowledge about dental health as possible to both child and parent. He must be able to demonstrate technical skill and professional ability and must make the most of this contact by stressing the importance of dental health, for it offers him an opportunity for future sales. It also affords him an opportunity to become a part of the health program in his community and to work on a group problem.

The examination programs in both dentistry and medicine are planned so that, at the end of the fourth year, they will be carried out in the dentist's and physician's own office. This will in no way impair the educational program, but will bring the child and parent into the

dental office, where they should rightfully receive this service.

The dental examination is recorded in triplicate, one copy going to the family dentist, one to the parent and one to the health department. Each family is furnished with a folder by the health department for the filling of the child's physical and dental examination blanks from year to year. The blanks are such that the family physician and dentist can use them in their offices and continue this service to the parent when the examinations are discontinued in the school. In several communities, we have been able to have the examinations in the dentist's office after the first year and no difficulties have developed to make it an inadvisable procedure.

After the examination program has been completed, the educational work is continued in the schools, and emphasis is placed on the importance of early care and mouth cleanliness and their relation to general health, with the hope that many of the defects will be corrected. After the educational work is well underway, a remedial program is started, and again not with the idea of taking care of all the defects or trying to have all the children in the school 100 per cent perfect as far as their teeth are concerned, but to serve as a true preventive project for the dentist, the teacher, the child, the parent and other cooperating groups. This program is confined to an age-grade group where prevention can be practiced. All work being done in the local practitioners' offices. The children naturally divide themselves into three groups: (1) the full pay patients, who will see their family dentist of their own volition; (2) the part-pay patients, and (3) the indigent. For the two latter groups, the health department has funds available to pay the dentist for services rendered to these children. This entire group is checked up from year to year so that we will be able to demonstrate the advantages of prevention to the group we have thus made contact with. All financial questions in regard to indigent and part-pay cases are first checked by the health department and then referred to the dentist for his approval. This allows the dentist to have the final say as to whether he believes the case a worthy one. It also allows him to treat these cases in exactly the same way as he does the remainder of his private patients; for, after the case has been referred by the health director, he makes an appointment with the patient by 'phone or mail.

An educational committee in each county society has developed suitable lectures for all groups that desire speakers on dental health. Slides, charts, movie films and a movie machine are kept in the local health department for the use of the dentists. Most requests for such lectures are referred to the health director by the health counselor, and he in turn makes contact with the dentist in the territory from which the request comes. The health department also furnishes the dentist with a large number of educational pamphlets for use at these meetings as well as in their individual offices.

This year, the dentists have developed a definite prenatal program in cooperation with the physicians. The expectant mother is advised by her physician to see her dentist in regard to her own teeth and for instruction in regard to measures to be followed that will increase the chances for her child to have sound, healthy teeth. This program is definitely educational and places a real responsibility on the dentist, for he must now be a teacher, if never before, and must give this mother worthwhile information. This program requires that the dentist and physician both understand their responsibilities and

assures much closer cooperation between the two professions.

It was our desire to assist the dentists in preparation for their part as we did the teachers by offering them instructions in regard to the procedures that it was necessary for them to use in conjunction with this program. Speakers in the various fields of dentistry are secured for their meetings. These meetings are in the nature of postgraduate conferences, in which the dentists themselves put on the morning program, and are followed by clinicians and speakers in the afternoon and evening. Scholarships for two weeks' postgraduate instruction at leading dental schools are offered, whereby the dentists have an opportunity of familiarizing themselves with the newer developments and advances the profession has been making. These courses place special emphasis on the newer preventive procedures, and children's dentistry and its related fields. To date, every dentist in the area has been away for one of these courses. This program will be continued from year to year, each dentist having an opportunity to take at least one week of postgraduate instruction in a class A dental school.

Combined meetings with the physicians are held regularly and related subjects are discussed by men representing both professions. The same type of postgraduate instruction is held for physicians. The majority have already availed themselves of two weeks' postgraduate instruction in pediatrics. This year, they will devote considerable time to the various phases of communicable disease, again going away for intensive postgraduate instruction.

All procedures and plans for the program are discussed in the local medical and dental meetings. Advisory committees to the executive council of the foundation, representing the medical society, dental society, school superintendents, county supervisors, sanitary engineers and health directors, meet from time to time to advise the council on the various programs before they are presented to the societies as a group.

The various social workers in the county are organized and meet regularly to add their cooperation to that of the other groups. The youth organizations and the service clubs all have an understanding of the program and hold encampments from time to time as do the other cooperating groups.

We believe that unless all the groups are participating in a truly coordinated program reaching into all branches educating the child, the results obtained with the individual child will vary tremendously. All we ask is that these local groups understand and handle the problems themselves and learn from their own experience and those of the others in the project.

A great many of our health programs have been too impersonal. The parent and the child have had little chance to learn of health matters directly from the physician or dentist. Specialists in the various fields of health have been brought into the community and clinics have been established, and the parent has had to be satisfied with the teacher's interpretation of the nurse's interpretation of the physician's or dentist's written order. The community has been led to believe that these groups were much better prepared to handle their health needs than was the local practitioner of medicine or dentistry. By assisting these local groups to understand the various problems and offering them assistance in preparing themselves to handle these problems, by actually working with them and by offering the means for postgraduate instruction, we are, we believe, rendering the community a greater service and

SCOUT'S HEALTH HISTORY

(To be filled in by parent or guardian)

NOTE TO THE PARENTS:

It is the wish of the Boy Scouts of America that your boy gain from his Scouting experience much that will benefit him in later life and aid him to establish the habit of keeping himself physically strong, mentally awake and morally straight.

So we ask you to help us by giving us the information that is asked for below so that your boy's Scoutmaster may plan his program to fit the physical ability of your boy as well as the rest of the boys in the Troop.

If you are willing to do so, we should be pleased to have you answer these questions:

IS HE SUBJECT TO (answer yes or no)	HAS HE HAD	DOES HE HAVE
Headaches?	Measles?	Heart Trouble?
Fainting Spells?	Mumps?	Asthma?
Sore Throat?	Chickenpox?	Lung Trouble?
Cramps?	Scarlet Fever?.	Hernia (Rupture)?
Stomach-ache?	Infantile Paralysis?	Defective Eyesight?
	Typhoid Fever?	Defective Hearing?
	Pneumonia?	Ear or Sinus Trouble?

Do you know of any other physical disorder or defect that should keep him from taking part in the regular Scout Program of activities?

Is he now, or has he been within the past year under Medical Care?

For what? Does he walk in his sleep?

Has he been exposed to any contagious disease within the last three weeks?

What? Has he been protected by inoculation or vaccination against Diphtheria?

Smallpox? Typhoid?

MEDICAL EXAMINATION BY REGISTERED PHYSICIAN

NOTE TO EXAMINER: The applicant wishes to become a Scout. He will participate in a program of strenuous outdoor activities including swimming and climbing. Your cooperation in making a careful examination will be greatly appreciated and will enable us to aid the boy in securing and maintaining physical fitness. Before giving your examination, please note carefully the health history above, as given by the parents.

Height Weight Standard weight (for age and height)

Posture General Nutrition

Musculature Skin Superficial Glands

Head Nose Throat

Pulse Rate Heart Sounds

Lungs Abdomen Hernia

General Nervous System

Eyes, Right Left Glasses Ears, Right Left

Urine—Albumen Sugar Sp. Gr.

Signed

Please Note on Separate Sheet Specific Recommendations to Parents or Scout Leaders

DENTAL EXAMINATION BY REGISTERED DENTIST

NOTE TO EXAMINER: Examiner will please outline the forms of cavities and fillings, within the square representing the tooth. Diagrams are for occlusal, buccal and labial surfaces. Designate kind of restoration by initial letters: Amalgam, A; Gold Foil, F; Gold Inlay, I; Silicous cement, S; Cement, C; Crown, Cr.; Teeth missing, M; to be extracted, X.

PERMANENT DENTITION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

TEMPORARY DENTITION

	A	B	C	D	E	F	G	H	I	J
X-Ray Films										
	K	L	M	N	O	P	Q	R	S	T

193

Investing Tissues Mouth Hygiene Notes

Teeth Malposed Teeth Malformed Notes

Signed D.D.S.

Please Note on Separate Sheet Specific Recommendations to Parents or Scout Leaders

building up a program that will weather all financial or political storms and that cannot be taken away from them.

Covered Wagon Council Health Record

The Covered Wagon Council Boy Scouts of America encourages its youthful members to have all needed medical and dental defects corrected as early and in the best way possible. Necessarily, each boy's case must be considered separately and individually.

Each unit (sub pack, scout troop or sea scout ship) designates the responsibility to one member of the adult committee, who cooperates with that particular unit. This member, if necessary, secures aid from the central administration office. Copies of all examination and treatment records are filed in the central office.

Through this plan, the council hopes to prevent a host of serious physical defects in later life by calling attention to the many minor ones existing during childhood. The economic, social and humanitarian value of this system can hardly be estimated.

Allyn R. Moser, 1407 Medical Arts Bldg., Omaha, is chairman of the Covered Wagon Council's Health and Safety Committee.

It is hoped that other committees will adopt this or similar measures to instil in the minds of growing boys the value of good health. Dentists who are interested in Boy Scout work may write to Dr. Moser for further information. A part of the medical and dental record sheet is shown herewith.

E. H. Bruening, *Commissioner,*
Covered Wagon Council B.S.A.,
Omaha, Nebr.

Dedicated to Dental Health

The March, 1936, issue of the *New Jersey State Dental Journal* is to be dedicated to dental health. It is not being published merely as dental propaganda, but every consideration is being given to the dental health educational aspects that will appeal to the public. Special emphasis is placed on such subjects as preventive dentistry, diet, radiography, historical dental facts, advances in dentistry, relation of teeth to health, anesthesia, practical denture service, periodontia and orthodontia.

This journal will be a very valuable adjunct to your library and most useful to your patients. The cost is 25 cents. Order your copy from I. S. Zecher, circulation manager, *New Jersey Dental Journal,* 252 Jewett Ave., Jersey City, N. J.

Guggenheim Dental Clinic

One of the most interesting institutions, from the dental standpoint, in New York City, is the Murry and Leonie Guggenheim Dental Clinic, on East Seventy-Second Street. This benefaction of Mr. and Mrs. Guggenheim is housed in a building that was built especially for this purpose and is a model structure of its kind.

From its inception, Mr. Guggenheim insisted that the facilities of this clinic be devoted to those children whose parents were unable to pay for dental work and that there should never, at any time, be any fee charged.

The clinic is under the direct charge of John Oppie McCall, D.D.S., with an advisory committee of several well-known dentists. The plan in force is to confine this work to certain schools located in that part of the city which is contiguous to the clinic. This part of Manhattan is densely populated and the director works through the school authorities.

The child's teacher, whose knowledge of home and economic conditions is very reliable, makes the initial selection. This selection is based on the teacher's knowledge of the above-named conditions, subject to a check-up by the clinic's trained social service worker.

Dr. McCall recently made the statement that any complaint made to the clinic

by dentists in the neighborhood is carefully investigated, and if it is found to be justified in even the slightest degree, the patient is discharged. He said that in four and a half years, with more than 20,000 children admitted, there have been less than ten such complaints. This would seem to dispose of the idea that this clinic is in any way a competitor of the dentist in private practice, as has recently been charged in one of the dental magazines.

Dr. McCall said further, "Another condition which demonstrates that the clinic is admitting only those children whose parents are economically unable to pay for dental service is the small number of those admitted who have had previous dental care. Less than one half of 1 per cent have had such care. These were admitted to the clinic because the family income had been reduced to a subsistence level as the result of the depression."

These children are brought to the clinic in a bus, in charge of a teacher. They are taught tooth brushing and their teeth are given a thorough cleaning. A roentgenray and a clinical examination are made, and subsequently the child receives complete dental care.

The policy of the clinic, as to its attitude toward and its treatment of the individual children, is to build up a feeling of appreciation of dental care and a desire to continue to seek such care after the child has reached the upper age limit of the clinic. That this will result in developing an interest in dental care in these children now being served, who are the adults of tomorrow, is unquestioned. Also, these children convey to their parents and other adults in the neighborhood the ideas that they have received in the clinic as to the benefits of oral health.

Obnoxious Radio Advertising Canceled

Utah's new anti-advertising law has recently been violated by certain dental laboratories in that state, which have been advertising dental services over the radio and in the press. While their advertisements were presumably meant for the dental profession, they reached the public as well. When the public, lured by the advertisements, appeared at the laboratories for dental service they were referred to certain dental offices for care.

E. W. Lambert, secretary of the Utah Dental Society, immediately took the matter up with Dr. Winter, President of the American Dental Association, who, in turn, notified Dr. Patterson, chairman of the A. D. A. Legislative Committee. Dr. Patterson relayed the information to Dr. Cole, vice chairman of the Legislative Committee in Washington, D. C., and Dr. Cole made contact with Dr. Camalier, chairman of the Dental Educational Publicity Committee of the Board of Trustees and of a special committee of the National Association of Dental Examiners.

Dr. Camalier's committee immediately made contact with Mr. James W. Baldwin, managing director of the National Association of Broadcasters, and, within two days thereafter, the broadcasting stations in Utah canceled all contracts with dental laboratories who were making these objectionable broadcasts. In taking this prompt action, the National Association of Broadcasters expressed its pleasure in cooperating with the American Dental Association in this matter and any other similar complaints.

In response to this action, the following telegram was received by the chairman of the committee from the Secretary of the Utah Dental Association:

A GLORIOUS VICTORY FOR ETHICAL DENTISTRY STOP OUR GRATITUDE AND THANKS
UTAH STATE DENTAL ASSOCIATION

The American Dental Association, through its President and the committees involved, is pleased to report this action in behalf of the ethical dentists of Utah and consequently of the United States.

DENTAL ECONOMICS

THE PHYSICIAN LOOKS AT DENTAL EDUCATION*

By JAMES S. McLESTER†, M.D., Birmingham, Ala.

THE regard in which a profession is held, and its usefulness, depend in large degree on the depth of culture and the breadth of learning of its individual members. Recognizing this, the medical profession has been engaged for the past twenty-five years in the elevation of educational standards, and today, I am told, the dental profession is concerning itself with the same process. How rapidly you are proceeding and how well satisfied you are with results, I am not informed, but as a former member of the Council on Medical Education of the American Medical Association, I may be able to tell you something of the difficulties we have encountered and to draw an analogy between your problems and ours.

Thirty-three years ago, just after the Boer War, a British medical officer told me this: The Medical Corps of the British Army in South Africa was ordered to accept without scrutiny the graduates of any European medical school, but not those of American schools. The latter must undergo investigation. This humiliated me greatly, for that order was issued with good reason. At that time, in 1900, while we had many of the best medical schools, we also had many of the poorest. Indeed, it has been stated that we were distinguished by having all of the poorest. Now, all of that is changed. Any physician who has graduated in the past ten years from a recognized American school has had excellent training, the equal of the best. This has come about through the work of the Council on Medical Education of the American Medical Association. This council began about twenty-five years ago to inspect medical schools and to rate them as Class A, B or C. The schools were graded upon many things, but, first of all, upon their entrance requirements and the fidelity with which these were observed. I can remember the time when a man of the most elementary education, or none at all, if he were ambitious and had saved a little money, could, without further preparation, enter immediately on the study of medicine. Now, every American school, preliminary to acceptance, demands as a minimal educational requirement two years of college work. Most of them require a bachelor's degree. The schools were graded also on the number of full-time teachers, the character of the curriculum, the adequacy of hospital facilities, the equipment of the laboratories, the library, the physical plant and many other things.

You will wonder how a body of this kind, without legal authority, could enforce its rulings. The council's influence first became effective when the several state legislatures recognized its classification and decreed that their examining boards would license for the practice of medicine only graduates of Class A schools. Those schools rated as B and

*Read at the Second General Meeting of the Seventy-Seventh Annual Session of the American Dental Association, New Orleans, La., Nov. 5, 1935.

†President of the American Medical Association.

C were then forced to improve their standards and facilities in such a manner as to merit the A rating or to close their doors. About half of the total number followed the latter course. As a result, with the exception of a few so-called "outlaw" schools, all American medical schools are now of the highest grade. Were I to meet that European officer today, I could truthfuly say that in America we have no poor medical schools, that our least efficient is the equal of their best, and that our best are unequaled in the world.

Standardization is of course the big problem. It has always been so with us, and will be so with you. True, there will always be a few outstanding schools with liberal endowment, directed by men of vision, and in dentistry, as in medicine, these schools will lead the way. In point of equipment, admission requirement and excellence of teaching personnel, they will meet, and in some respects excel, all ordinary standards. But, these are not the schools with which we are concerned. It is the school with insufficient means, the school that leans solely or even too heavily on the tuition that the student pays, that is our chief concern. Such a school, too often, has a teaching staff composed largely of part-time men who are heavily burdened with every day practice. It is an old, old argument that a certain number of schools of lower grade should be recognized in order to afford opportunity to the boy of limited preliminary education, the boy who, because of restricted funds, must hurry through his professional training. "Give the poor boy a chance" is what we have heard time and again. But we have found in medicine, as I know you are finding in dentistry, that this is a fallacious argument. The answer should be "Give the patient a chance." To do anything else is fatal. Must we lower the standards of the profession, must we lessen the average of efficiency and must we destroy the esteem in which physicians and dentists as a whole are held in order to give the poor boy a chance? However much we may sympathize with the ambitious boy who has neither the time nor the means to meet the higher standards of education, we must, in the interest of the public welfare and of the profession as a whole, answer no. In dentistry as in medicine, the profession must strive continually to elevate its educational standards.

How high should these standards be? It is obvious that the law of diminishing returns applies here as elsewhere and that we could, in our enthusiasm, conceivably raise standards to an impossible point. Theoretically, they should be elevated to the point at which the maximum benefit occurs to the greatest number. Whether we have reached this point in medicine and whether you are approaching it in dentistry, it is difficult to say. Of far reaching importance was the action of the Council on Medical Education and Hospitals of the American Medical Association when it recently appointed a "blue print" committee whose function it will be during the next two years to study this question, and to determine, as accurately as possible, the type of medical training that will be required of their physicians by the American people of the future. Guided by these studies, this committee will draft plans for the curriculum of tomorrow, and according to their ability to meet these new standards, medical schools will again be classified.

It is true in both medicine and dentistry that in prescribing a minimum standard, we can go no faster than the public and the profession as a whole is prepared to go, but I am sure you have been pleasantly surprised in your profession, as we have been in ours, by the high

degree of sympathy exhibited by the American people toward your efforts. The public is prepared, it has seemed to me, to approve heartily the highest standards that the profession feels justified in establishing. Therefore, as an observer who, for twenty-five years, has watched with intense interest the development of medical standards to constantly higher levels, I can, I think, say to you that, in the standardization of dental education, you can, with full assurance of public support, afford to proceed rapidly and travel far.

The question of preliminary education is probably your most difficult problem, as it has been with us. Why should a liberal education in the arts and sciences be required of a man whose practice is to be confined to one limited sphere? The answer is simple: The education of a professional man is designed not merely to provide utilizable information of a technical nature, but rather to give the person in addition to his technical training, a broad view of life and to develop his mental processes. Is it important that the dentist be able to observe accurately, to correlate what he sees, and to reason soundly? If it is, and I think we can all so agree, he must have a well-trained mind and a broad cultural background such as is associated only with a good preliminary education. I hope this Association will always prescribe as a minimal requirement for admission to the study of dentistry a relatively high degree of preliminary education, the equivalent, say, of at least two years of college work and that suitable means will be found for enforcing the observance of this standard.

There are other equally important things. We must freely admit that standards of admission do not constitute everything, and that neither do curriculum and equipment. We can have all of this and yet fail because the influence of the teacher on the pupil is lacking. The most important thing in any educational program is that subtle indefinable influence which the teacher, consciously or unconsciously, exerts in molding the character and developing the methods of thought and the scientific ambitions of the pupil. It is recognized that the physician or dentist who is engaged not only in teaching, but also in the practice of his profession, brings to the pupil a human interest that is thoroughly essential and without which he would develop in a one-sided manner, but the full-time teacher who is engaged solely in teaching and in research exerts an influence of equal importance. The full-time teacher stimulates the pupil's interest in the pure sciences and helps to give him the inquiring, the skeptical turn of mind that is so important to the advancement of any profession. In the fixing of standards, therefore, much thought should be given always to the number of full-time teachers of professorial rank required of the school. True, full-time teachers of the right type are not easy to find and the necessary funds are not always available; but such men are essential.

The necessity for adequate endowment is obvious. We have found in medicine, as I believe you are finding in dentistry, that teaching is such an expensive thing that, to merit approval, the school cannot subsist solely on the fees provided by students. The day is long past when the expenses of a school of medicine or dentistry can be adequately met by the pupils' tuition. The fact had best be faced squarely that to meet educational standards the dental school must have in liberal amount other sources of income than that supplied by the student.

I should like to say just a word regarding the personnel of your standard-

izing board. I think we can agree that such a board is essential. Fortunately, I do not know how your board is formed and therefore, without embarrassment, can tell you of ours. The Council on Medical Education and Hospitals of the A.M.A. is composed of seven members, who are nominated by the president of the American Medical Association. Each serves seven years. This council is responsible only to the house of delegates. It frequently includes in its conferences the representatives of the Association of American Medical Colleges and other agencies, but such outside agencies have no voice in its deliberations or its final decisions. These last are made by the council alone. This makes for a singleness of purpose and an independence of action that otherwise could not be obtained.

If the dental profession is to merit the confidence and the high regard of the American people to which you and I believe that it is entitled, educational standards must be raised to constantly higher levels. This, I believe, can be accomplished only through the regulating influence of a small completely independent standardizing board.

MEDICINE AND SOCIAL CHANGES*

By R. G. LELAND,† M.D., Chicago, Ill.

MEDICAL economics is as old as medicine. History records that the early emperors required physicians of that time to treat the poor without charge, and to limit their fees for others according to the amounts prescribed by the rulers' orders.

A careful analysis of the economic principles underlying professional services has hitherto been lacking. An understanding of the problems that confront the medical and dental professions requires recognition and application of general principles pertaining to the production, distribution, exchange and consumption of professional services, as contrasted with commercial commodities or material goods.

These principles of medical economics are necessarily closely related to medical ethics. The first principle of medical ethics declares, "A profession has for its primary object, the service it can render to humanity; reward or financial gain should be a subordinate consideration. The practice of medicine is a profession. In choosing this profession, an individual assumes an obligation to conduct himself in accord with its ideals."

This and the other principles of medical ethics were established voluntarily by an independent profession, and not because of any legislative or bureaucratic compulsion. The origin can be traced to some time in the fourth or fifth century before Christ, and the basic principles then established have survived throughout these more than twenty centuries of social, political and other forms of strife and evolution.

Moreover, without any compulsion on the part of forces outside the professions, medicine has sought constantly to advance the standards of medical education, medical licensure and hospital practice, and now seeks the certification of specialists. All this and more has been done by medi-

*Read at the Second General Meeting of the Seventy-Seventh Annual Session of the American Dental Association, New Orleans, La., Nov. 5, 1935.

†Director of the Bureau of Medical Economics of the American Medical Association.

cine for the benefit of the people. During the last century, life expectancy at birth has been increased from about 28 years to nearly 60 years. There have been amazing improvements in the methods of diagnosis and treatment, and there has been a striking reduction in the incidence and mortality from many preventable diseases.

Consistent with its ideals, ethics and traditions, medicine is now seeking to improve the methods by which medical care is distributed. The medical profession has made more experiments in the distribution of medical care than have all its critics, nearly all of whom try simply to apply the experiments of commodity economics which in themselves have been known to succeed.

The medical professions of the world have never opposed advances and improvements that would benefit health, relieve suffering or postpone death.

Medicine cannot hold itself completely aloof from the social changes of our times. The medical profession differs with the propagandists for social reform who would change completely the methods of medical practice. Physicians believe that improvements in the practice of medicine should be made whenever and wherever necessary, but they are equally insistent that the sound principles that have been so thoroughly tested over long periods of time, and the ethics, ideals and traditions that have survived for more than twenty centuries, must be preserved for the future of medicine and for the welfare of humanity. The acceptance and application of any system of medical practice that wrests control of medical affairs from those who, by training and experience, constitute the only group competent to judge the necessity and character of the service will most certainly result disastrously to both the medical profession and the people it serves.

If medicine and dentistry are to retain a high regard for the time honored and universally respected traditions of the professions, if they are to preserve the high standards of performance necessary to good service, if they are to safeguard for future generations of physicians and dentists and for the general public welfare the institutions of medicine and dentistry, they must continue to advance scientifically; to give good medical and dental care; to devise means of making their services available to all at fees adjusted to current economic conditions; to coordinate more closely preventive and curative medicine and dentistry; to present a single collective voice and consistent efforts regarding social, ethical and legislative affairs; not merely to oppose, but to be positive and constructive in plans and actions; to prepare oncoming generations of physicians and dentists, while still in college, for a better understanding of the economics of medical and dental practice; to cling to the principles of medical ethics; to continue to differentiate sharply between honest scientific care, and the spurious imitations of the cults, quacks and charlatans, and to continue to believe in the institutions of medicine and dentistry.

A PROPOSED NEW DENTAL LAW

There is a movement in Mississippi proposing a new dental law that may serve as an example to other states and settle forever the problems of ethics and membership in the American Dental Association.

This law is patterned after one that the legal profession adopted in that state four years ago, and the purpose is to have the legislature grant the state dental society the same privileges that it granted the state bar association.

The General Laws of Mississippi, 1932, Chapter 121, requires "all lawyers to be members of the Mississippi Bar Association." It "will have the right to make rules and bylaws, conduct educational and social meetings and generally do such things as in their judgment may tend to improve the educational standing of the bar."

Thus, the Mississippi Bar Association is made a state regulatory body, and every lawyer must not only become a member but must conform to its code of ethics. Otherwise, he loses his membership and is automatically disbarred from practice.

This law is highly praised by judges and lawyers. It operates with such dispatch and smoothness as to put to shame some of our efforts in our own profession.

C. B. WARNER, A.M., D.D.S.,
Biloxi, Miss.

FEDERAL TRADE COMMISSION, WASHINGTON

The Federal Trade Commission has issued a complaint against S. B. Heininger, 440 Huron St., Chicago, charging unfair competition in the sale of dental plates by mail order, in violation of the Federal Trade Commission Act.

Heininger's advertising is alleged to have had a tendency to mislead purchasers into believing they could make correct impressions of their own teeth and gums, and from such impressions the respondent could make satisfactory artificial teeth.

The complaint also charges that the respondent's advertising tended to deceive purchasers into believing that they could obtain from Heininger artificial teeth comparable in appearance, fit, comfort and durability with those made in the usual way by practicing dentists.

The Commission fixed February 14 as the final date on which the respondent may show cause as to why an order should not be entered requiring him to cease and desist from the law violation charged in the complaint.

CURRENT LITERATURE

Repair of Postoperative Defects Involving Lips and Cheeks Secondary to Removal of Malignant Tumors (Gordon B. New and Frederick A. Figi, Surg., Gynec. & Obst., 62:182 [Feb.] 1936): The majority of defects about the mouth that come under the care of the plastic surgeon are congenital or traumatic, or are the result of treatment of malignant tumors. In treating localized inactive malignant lesions, an element of conservatism is justifiable, but extensive active growths must be removed widely, regardless of the deformity produced. It is often necessary to sacrifice a large portion of the upper or lower lip, or both, and occasionally a portion of the cheeks, jaws and floor of the mouth as well. The reconstructive procedures should be postponed until the lesions caused by surgical measures, or by the use of irradiation or escharotics, have completely healed, and enough time has been allowed for a reasonable assurance of no recurrence of the malignancy. The time varies with the nature, activity, previous treatment, situation and extent of the lesion, and with the age and general condition of the patient. A tumor that has been cleared up with irradiation may recur much later than one removed surgically. This is due to the fact that malignant cells lie dormant for a longer time in the dense scar tissue. Tumors of younger individuals are more prone to metastasize than are those of older patients. Plastic surgery should be delayed for from six months to one year. By this time, devitalized bone will have separated; the inflammatory re-

action will have subsided and the margins of the perforation will have healed. Recurrence of a malignant growth beneath the graft cannot, as a rule, be recognized until it is well advanced and presents a serious problem. The problem of repair following the removal of malignant tumors about the mouth varies greatly in different cases, depending on their situation and extent. The postoperative defects and their repair are dealt with at great length in this discussion. Numerous illustrations of various types of lesions before and after reconstruction work accompany the discussion. The technic is clearly explained for each type case.

J. FRANK HALL.

Surgical Prosthetics of Oral and Facial Defects (N. A. Olinger and E. F. Axt, Am. J. Surg., 31:24 [Jan.] 1936): Oral and facial defects amenable to prosthetic treatment may be grouped under (1) intra-oral defects including dental and alveolar of the maxilla or mandible and congenital or acquired of the palate and (2) extra-oral defects of the eye, ear, nose and cranium. The authors discuss prosthetic restorations of all these parts. In order properly to construct any prosthetic appliance, it is necessary to understand fully the normal structure and function of the part to be replaced. In properly selected cases, surgery is the method of choice for repair of cleft palate, but when quick, painless results are desired, the disease causing the deficiency makes surgical procedure doubtful, the defect is too extensive, the physical condition contraindicates operation or a temporary appliance is desired before plastic operations, prosthetic procedures are indicated. The technic for cleft-palate prostheses is described in some detail, "dentocoll" being used for the impression medium, vitallium preferred for the retaining denture and luxene often used for the velum. Teaching the patient how to use the appliance is an important part of the service. Five case histories are cited, with details of the construction of each appliance. The treatment of five cases of extra-oral defects is also given, including two instances of ear replacement, two of the nose and one of the orbit and cheek. The importance of cooperation between the surgeon and prosthodontist is emphasized.

HAMILTON ROBINSON.

Factors in the Quantitative Measurement of the Roentgen-Ray Absorption of Tooth Slabs. III Mechanical Factors of Tube and Machine (Harold C. Hodge; Grant Van Huysen, and Stafford L. Warren, Am. J. Roentgenol., 34:678 [Nov.] 1935): There is no regular variation introduced in the interpolated values for either dentin or enamel by changes in the intensity or the time of exposure at a constant kilovoltage (i x t=C); or distance if the proper exposure is made; or focal spot size and shape if the proper distance and centering are used. These results are to be expected but it was necessary to verify them experimentally so far as this procedure was concerned. Increase in kilovoltage (quality of radiation) decreases the slope and changes to a certain extent the position of the D-T curve, but does not influence the interpolated value (I.V.) for the dentin. The increase in the I.V. for enamel is due to another factor (difference between the coefficients of absorption of enamel and aluminum) and will be discussed later.

J. FRANK HALL.

Effect of Fluorine on Phosphatase Content of Plasma, Bones and Teeth of Albino Rats (M. C. Smith, and E. M. Lantz, J. Biol. Chem., 112:303, 1935): A study made of the effect of sodium fluoride on the phosphatase content of the plasma, bone and incisor teeth of albino rats of the same age, sex and litter shows that as the plasma phosphatase of normal control rats decreases with age, that of rats whose ration contains 0.1 per cent sodium fluoride also decreases, but more slowly. The values are lower than those of control rats until the age of 70 days, after which they are slightly higher. Rations containing 0.025 per cent sodium fluoride, enough to produce mottling of enamel, cause no phosphatase changes from normal. A high fluorine diet causes slight decrease in phos-

phatase content of incisor teeth and little difference in bone. It is concluded that fluorine does not exert its characteristic influence on the teeth of rats through a change of the enzyme involved in tooth and bone calcification, nor can the plasma phosphatase content be used as an indicator of fluorisis in rats.

M. LeFevre.

Diagnosis and Treatment of Malignant Tumors of the Nasal Sinuses (G. Allen Robinson, Am. J. Roentgenol., 34:641 [Nov.] 1935): The author reports on a series of sixty cases of malignant disease of the sinuses, in which twenty-seven patients were males and thirty-three females. Fifteen of the sixty were below 40 years of age, twelve between 40 and 50 years, twenty-one between 50 and 60, and twelve between 60 and 80. In most instances, the diagnoses were made in the advanced stages. The patient had not presented himself for an early examination or the family physician or dentist had not correctly diagnosed the case. In the very cellular radiosensitive types, such as lymphosarcoma, lymphoepithelioma and some types of carcinoma, radical surgical procedure is contraindicated. In the very cellular types, external irradiation should be sufficient to destroy the growth. If infection and osteomyelitis accompany the malignant disease, operation is indicated for drainage. The application of radium to the sinuses after drainage is simpler. When all evidence of malignancy is eliminated, plastic operations and dental procedures should be practiced to correct the defects. J. Frank Hall.

New Treatment for Acute Osteomyelitis (R. E. Humphries, Am. J. Surg., 31:145 [Jan.] 1936): Acute osteomyelitis is an infectious disease with subperiosteal abscess formation. The accepted treatment of incision and drainage, in the author's opinion, allows the escape of infection from the area, which has been walled off by nature, and leaves an open wound that may readily become contaminated. In osteomyelitis, fear, worry, anger and fatigue prolong the disease and also play a part in starting the condition. Since digestion is thereby affected, food poisons may accumulate, be absorbed into the blood stream and lower the resistance to other infectious agents. In osteomyelitis, the patient should be placed on a liquid diet, the intestinal tract thoroughly evacuated and splints applied to the parts for relief of pain. In a series of twenty cases of the long bones so treated, no deaths occurred and recovery was uneventful in all but one instance. The disease has not recurred in any of the limbs so treated. In seven cases, no abscesses formed, and in the remaining thirteen, the abscesses opened spontaneously.

Hamilton Robinson.

Carcinoma of the Mouth (By H. L. Albright, Radiology, 25:24 [July] 1935): Albright points out that more than 90 per cent of malignant tumors of the mouth are epidermoid carcinomas, mostly of the adult resistant type. Of the buccal epithelium, the basement cell alone has the power of reproduction and of invasion. All other cell changes represent stages of degeneration. Epulis, regarded by some as a granuloma, is "semimalignant." Leukoplakia is the most important precancerous lesion. All cases of leukoplakia are curable. Enlarged cervical nodes should be regarded as cancerous. Once cancer invades the cervical nodes, the chance for cure is practically lost. Early diagnosis will improve the results more than any other single factor. Radium is the remedy of choice in the primary lesion in all cases that have extended beyond the possibility of easy operative removal. Intratumoral radium must be of epidermicidal intensity, whether over a short or long period, to be reliably effective. In this form, it is the best caustic for cancer. The 1934 technic of Radiumhemmet, Stockholm, and Institut du radium, Paris, are presented. What cures there are in cancer of the tonsil have come from irridiation, which must be rigorously employed. In the treatment of the cervical lymphatic areas, irradiation is uncertain. It should be used only in combination with surgery, which should be early and radical. The penalty of waiting until nodes develop is too great. Grading of tumors is of spe-

cial importance in determining group prognosis. Better management of the individual case will result from the surgeon and radiologist working together.—*J.A.M.A.*, Sept. 14, 1935.

Foreign Literature

Surgery in Moscow. Storage of Blood for Transfusion (George Sacks, Brit. M. J., 2:1118 [Dec. 7] 1935): Much has been written on medical organization in the Soviet Union. The more specialized field of surgery has possibly not received the attention that it deserves. The author recently visited the Skifassovski Hospital and he describes, among other things, their technic for blood transfusion, popularized by Professor Yudin. Within six hours after death from suicide or street accidents, or from angina, blood is drawn off, typed, subjected to the Wassermann test, collected in jars and preserved in ice chests. Postmortems are carried out on the cadavers to determine whether the blood is suitable for transfusions. The special merit of this method lies in the fact that blood cannot clot, the use of citrate thus being obviated. Such blood is not kept for longer than six or seven days. Since one cadaver yields about 3 or 4 pints, there is always a plentiful supply of typed blood available for emergency purposes. The objection to this method is that this blood has not so high a hemoglobin index as fresh blood. The use of the preserved blood in the Skifassovski Hospital is a routine measure.

J. Frank Hall.

Snake Venom and Its Use in Dental Hemorrhage (J. D. Cambrook, Proc. Roy. Soc. Med., 29:281 [Jan.] 1936): Experiment showed that the venom of Russell's viper would coagulate in a 1:10,000 dilution ten times its volume of hemophilic blood in less than twenty seconds. In this dilution, the minimum lethal dose would only be contained in 4.2 liters. After extraction under local anesthesia for a reputed bleeder whose history has been carefully checked, a plug soaked in hot venom is inserted in the socket and pressure applied at the edges. The patient is allowed to bite on a gauze roll and the plug is left in position until it falls out. If hemorrhage occurs, another plug is inserted, and this is repeated as many times as is necessary. The variations in treatment are given and two cases of failure cited. While this is not an absolute method for stopping all hemorrhage, it does afford a valuable means of control.

Hamilton Robinson.

Radiation Therapy in Tongue Carcinoma (R. A. Gardner; Brit. M. J., 2:1090 [Dec. 7] 1935): In males the tongue is one of the most common sites on which carcinoma occurs. The loss of the tissue of the tongue produces a most distressing mutilation, and therefore it is of paramount importance to conserve as much normal tissue as possible. Treatment should be started at an early date. Carcinoma of the tongue is a local disease particularly before it has extended into the regional glands and is curable if there is sufficient irradiation. There are several possible methods of irradiating the primary growth of the tongue, which the authors explain fully. Interstitial, surface or distance methods of applying radium or radon may be employed, or roentgen rays may be applied from a greater or lesser distance. The results of irradiation in cases of carcinoma of the tongue are from some aspects very satisfactory if treatment is started in time.

J. Frank Hall.

Primary Diphtheria of the Oral Mucosa (K. Oxenius, Deutsche Med. Wchnschr., Nov. 8, 1935, p. 1803): The author reports two cases of primary diphtheria at the site of erupting deciduous teeth, with no other mucous tissue involved. Both patients were between 1 and 2 years of age. The familiar dirty gray patch appeared behind the upper premolar region in either case. A swab confirmed the diagnosis of diphtheria. After the injection of antitoxin units, the membrane disappeared. It is believed that the infection was contracted by the patients' rubbing the fingers over these areas.

J. Frank Hall.

ABSTRACTING GROUP, A.D.A.

Following is a revised list of the group at Rochester University who are providing abstracts from current literature for THE JOURNAL:

Abstractor	Periodical
A. D. Brashear	Journal of Comparative Neurology
J. F. Hall, D.D.S.	American Journal of Clinical Pathology American Journal of Roentgenology British Medical Journal Journal of Bone and Joint Surgery Radiology Surgery, Gynecology and Obstetrics
M. K. Hine, D.D.S.	American Journal of Hygiene Journal of Bacteriology Journal of Experimental Medicine Journal of Immunology Journal of Infectious Diseases Journal of Pathology and Bacteriology
H. C. Hodge, Ph.D.	Zeitschrift für Stomatologie Zeitschrift für Physiologische Chemie Biochemische Zeitschrift Journal of Nutrition Transactions of the Society of Experimental Biology and Medicine
Marian L. LeFevre, M.S.	American Journal of Diseases of Children British Journal of Diseases of Children Journal of Biological Chemistry Journal of Biochemistry
R. S. Manly, M.A.	Journal of the American Chemical Society Journal of Industrial Engineering Chemistry Zeitschrift für klinische Medicin
M. W. McCrea, D.D.S.	American Journal of Anatomy Archives of Surgery Journal of Anatomy Lancet New England Journal of Medicine
Hamilton Robinson, D.D.S.	American Journal of Cancer American Journal of Pathology American Journal of Surgery Archives of Pathology Archives of Dermatology and Syphilology Journal of Laboratory and Clinical Medicine British Journal of Experimental Pathology
Grant Van Huysen, D.D.S.	American Journal of Physical Anthropology Anatomical Record

MISCELLANY

BOOK REVIEWS

Black Ivory. By Edward Samson, L.D.S. Eng., F.C.S. Honorary Dental Surgeon to the Royal Victoria and West Hants Hospital, Bournemouth; Borough Dentist to the County Borough of Bournemouth. With a prefatory letter by Sir William H. Willcox, K.C.I.E., C.B., C.M.G. 179 pages. Price, 6 shillings. Published by Henry Kimpton, 263 High Holborn, W. C. I., London, 1936.

This is a very significant dissertation on a subject of universal interest to the dental profession by a man of keen observation. It is no less than the discussion of dental disease starting with the anomaly presented by conditions in the Island of Tristan da Cunha, where dental disease is practically unknown and where all of the conditions are present that would seem to invite dental disease; and ending with the appalling dental conditions found in most other parts of the world.

Though much has been written on Tristan da Cunha, there never has been any tenable theory given to account for it, so all of the conjecture has practically gone for naught, and we are no nearer a solution of dental caries than we were before Tristan da Cunha came into prominence. In "This Way Salvation," the author of this book argues for "Coordinated Research as the Remedy," and intimates that a national laboratory of dental research should be established and maintained. All of this is laudable enough and one is inclined to exclaim "more power to the plan," but all of the research laboratories in existence will not solve the problem of dental caries without a different approach from anything that so far has been made. It is not solely a matter of diet, nor is it any one clinical manifestation alone. Not to emphasize an anachronism we might suggest that while the subject is very broad, it will be solved only by the closest and most intimate study of the actual environment in the mouth. We must at the same time look far afield and close at hand.

Glandular Physiology and Therapy. A Symposium prepared under the auspices of the Council on Pharmacy and Chemistry of the American Medical Association, 1935. 528 pages. Price, $2.50. Published by the American Medical Association, 535 North Dearborn Street, Chicago. This is a book of twenty-six contributors among whom may be found some of the leading men of the medical profession. It is a highly technical presentation of an important subject prepared under the auspices of the Council on Pharmacy and Chemistry of the American Medical Association. The introduction is by Morris Fishbein, M.D., editor of *The Journal of the American Medical Association,* which assures a logical though brief presentation of the subject. The significance of the glands of the body is becoming more and more apparent, and to any one interested in the subject, the present volume furnishes a very comprehensive study. As far as such a subject can be made authoritative, this book may be accounted an authority.

Vitamins in Theory and Practice. By Leslie J. Harris, Sc.D., D.Sc. Nutritional Laboratory, University of Cambridge, and Medical Research Council. 240 pages. 66 illustrations. Price, $3.00. Published by the Macmillan Company, New York City, 1935.

We have been hearing so much about the various vitamins in recent years that anything authoritative on the subject must appeal to us. The present book is made up of a series of four lectures given at the Royal Institution, London, in 1934. The author has presented his subject in a "frankly colloquial tone," which relieves it of the usual dry technical treatment often accorded subjects of this character. The book is not hard to read, and after it is read, if the reader cares to go farther into the subject and dig deeper, he may have

ample scope in the different acknowledgments or references in the beginning of the book. There are nearly three pages of these, which would seem to provide food for thought on most of the vitamin literature of the day. "The A B C of Vitamins," a pleasing poem signed by C. H. A., starts the volume off with a more or less rollicking jingle that is rather attractive, and it paves the way for the more serious consideration of the subject in the body of the book. We commend this book to anyone interested in the subject, and if there is anyone who is not interested, it is high time that he was.

CORRESPONDENCE

"Broken Needles in Mandibular Blocking"

To the Editor:

Dr. Schwartz's article on broken needles which appeared in the January issue was interesting. His simple methods for removing needles when broken in the course of blocking the mandibular nerve in the correct manner seems good. He includes a warning against haphazard methods of blocking, in the interests of helping to prevent needle fracture and in case of removal when fracture does occur. I should like to sound a further warning against the use of doubtful needles, as all will agree that prevention is best. I use nothing but an iridioplatinum; just the one long needle for all infiltration and blocking. My first needle of this kind bought in 1930 gave very little service before breaking at the hub in the course of a mandibular block injection. The needle was not provided with a guard, but owing to the tenacity of the metal it hung by a thread to the hub; which permitted withdrawal. In other words, it did not snap off as a steel needle does. Breakage in this case was due to poor methods of construction. The opening in the hub where the needle emerged was no larger than the needle itself, a tight fit without play resulting. Consequently, all of the bending stress was concentrated at that point. That needle was replaced with another of iridioplatinum which had play at the point of emergence from the hub. I provided it with a soldered gold guard. It has since been the only needle used in the office for all injections and it is flamed before and after each injection. Though my practice is not large, I am sure that my cost for needles during these years has been much smaller than if I had used steel needles. In addition, I have enjoyed the benefits of greater convenience and a far greater freedom from worry.

Justin McCarty, D.M.D.,
816 Fourth and Pike Bldg.,
Seattle, Wash.

SYNTHETIC RESIN USED FOR DENTAL GUM IN GERMANY

By Consul Sydney B. Redecker,
Frankfort-on-Main, Germany

A new and promising use developed in Germany for synthetic resin is as a substitute for rubber for dental purposes.

Owing to the severe shortage of foreign exchange, German imposts of dental rubber, formerly furnished largely by the United States, have been drastically curtailed and as success has not been achieved in developing in Germany a dental rubber equivalent to the genuine high quality American product, German dental circles turned their attention to synthetic resin for solving the problem.

The first dental gums of synthetic resin were found seriously deficient, owing especially to their extreme sensitiveness to temperature changes. Improvements in new resin compositions are reported to have completely overcome these objections, and it is stated that the new synthetic resin dental materials have proved excellent as substitutes for the rubber composition formerly imported.

At least one concern has undertaken the commercial manufacture of the new resin dental material, dental plates, etc., and it is claimed that the product is so successful that the manufacturers are confident of building up an export business, the first foreign orders, in fact, having already been booked.—Department of Commerce, Bureau of Foreign and Domestic Commerce, Washington, D. C.

1935 MEMBERSHIP RECORD

The following percentages have been obtained on quotas for constituent societies on the basis of a total membership of 45,000.

Alabama	83.74
Arizona	81.91
Arkansas	68.03
Army	102.50
California	82.64
Colorado	103.13
Connecticut	123.62
Delaware	82.81
District of Columbia	109.82
Florida	89.84
Georgia	71.45
Idaho	49.34
Illinois	88.06
Indiana	83.70
Iowa	98.23
Kansas	71.17
Kentucky	80.10
Louisiana	86.50
Maine	73.31
Maryland	62.81
Michigan	91.79
Massachusetts	64.64
Minnesota	118.39
Mississippi	76.92
Missouri	68.96
Montana	86.34
Nebraska	83.55
Nevada	65.85
New Hampshire	89.04
New Jersey	109.47
New Mexico	106.35
New York	67.14
North Carolina	89.41
North Dakota	96.92
Navy	116.82
Ohio	85.96
Oklahoma	82.20
Oregon	65.91
Pennsylvania	84.35
Rhode Island	69.58
South Carolina	62.86
South Dakota	81.19
Southern California	82.64
Tennessee	115.47
Texas	77.14
Utah	116.10
Vermont	88.65
Virginia	84.65
Washington	75.67
West Virginia	77.83
Wisconsin	100.96
Wyoming	98.38
U. S. Public Health Service	116.87
U. S. Veterans Adm.	106.74

JUNIOR MEMBERSHIP, A.D.A.

Following is the Junior Membership of the American Dental Association by states as of January 31.

Atlanta Southern Dental College	46
Baylor University	48
Chicago College of Dental Surgery	94
College of Physicians & Surgeons	100
Columbia University	23
Creighton University	1
Georgetown University	66
Harvard University	4
Indiana University	90
Kansas City-Western Dental College	33
Loyola University	86
Marquette University	115
Medical College of Virginia	35
New York University	16
North Pacific College of Oregon	29
Northwestern University	51
Ohio State University	125
State University of Iowa	51
Temple University	156
Texas Dental College	44
Tufts College	2
University of Buffalo	14
University of Detroit	60
University of Illinois	5
University of Louisville	14
University of Maryland	66
University of Michigan	32
University of Minnesota	48
University of Nebraska	18
University of Pennsylvania	1
University of Pittsburgh	1
University of Southern California	107
University of Tennessee	63
Washington University	22
Western Reserve University	76
Total	1,742

NEWS

Deaths

Dean, Elizabeth, H., Cleveland, Ohio; Western Reserve University School of Dentistry, 1929; died recently; aged 32.

Douglass, Adelbert, Augusta, Mich.; died December 23; aged 86.

Hinshaw, Loring L., Edinburg, Ind.; Indiana University School of Dentistry, 1882; died in December; aged 77.

Howard, E. G., Los Angeles, Calif.; International College of Dental Surgery, 1890; died in the hospital at San Diego, of pneumonia.

Swindler, Russell L., Logansport, Ind.; Indiana University, School of Dentistry, 1904; died December 13; aged 64.

Thomas, Ferd I., Logansport, Ind.; Indiana University School of Dentistry, 1897; died December 17; aged 62.

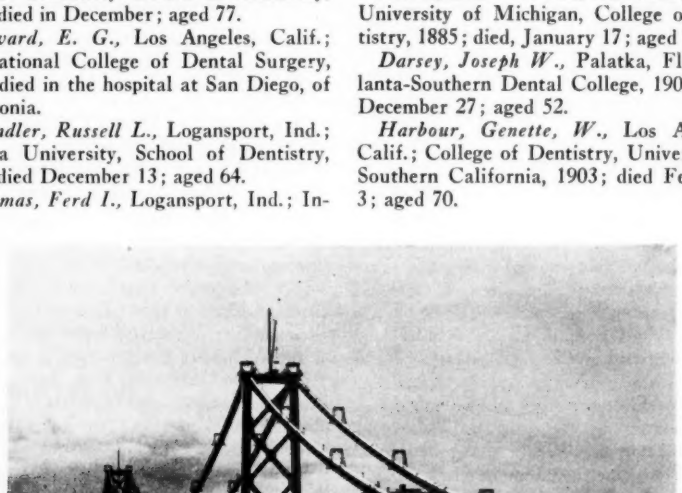
Werner, John F., Elkhart, Ind.; Ohio College of Dental Surgery, 1891; died December 1; aged 67.

Best, William Gilmore, Berea, Ky.; College of Dentistry, Ohio University (University of Cincinnati), 1905; died December 30; aged 56.

Bethel, Louis Prentiss, Columbus, Ohio; University of Michigan, College of Dentistry, 1885; died, January 17; aged 75.

Darsey, Joseph W., Palatka, Fla.; Atlanta-Southern Dental College, 1904; died December 27; aged 52.

Harbour, Genette, W., Los Angeles, Calif.; College of Dentistry, University of Southern California, 1903; died February 3; aged 70.



Oakland Bay Bridge; San Francisco in the distance.

Seventy-Eighth Annual Session of the American Dental Association, San Francisco, July 13-17

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, San Francisco, Calif., July 13-17.

American Academy of Restorative Dentistry, San Francisco, Calif., June 27-28.

American Association of Dental Schools, Louisville, Ky., March 16-18.

American Board of Orthodontia, St. Louis, Mo., April 17-18.

American Society of Orthodontists, St. Louis, April 20-23.

American Society for the Advancement of General Anesthesia in Dentistry, New York City, March 23.

Five State Post Graduate Clinic (Maryland, Delaware, Virginia, West Virginia and North Carolina), Washington, D. C., March 8-11.

American Dental Society of Europe, August, 1937.

International Dental Congress, Vienna, August 2-8.

Philadelphia County Dental Society (in combination with Pennsylvania State Dental Society), Philadelphia, February 4-6.

Texas State Dental Society and Texas Association of Oral Surgeons and Exodontists, Dallas, June 8-12.

Thomas P. Hinman Midwinter Clinic, Atlanta, Ga., March 9-10.

Society for the Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

District of Columbia at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

British Empire Dental Meeting, London, July.

Ontario Dental Association, Toronto, May 18-20.

American Dental Assistants Association, San Francisco, July 13-17.

STATE SOCIETIES

April

Alabama, at Birmingham (14-16)
Connecticut, at Stamford (15-17)
Kansas, at Salina (27-29)
Kentucky, at Louisville (6-8)
Louisiana, at Baton Rouge (26-28)
Massachusetts, at Boston (28-May 1)
Michigan, at Detroit (20-22)
Mississippi, at Greenville (13-15)
Montana, at Butte (16-18)
New Jersey, at Atlantic City (22-24)
Washington, at Seattle (30-May 2)
Wisconsin, at Milwaukee (21-23)

May

Arkansas, at Little Rock (11-13)
Georgia, at Atlanta (11-13)
Illinois, at Peoria (12-14)
Indiana, at Indianapolis (18-20)
Iowa, at Des Moines (5-7)
Maryland, at Baltimore (4-6)
Nebraska, at Lincoln (18-20)
New York, at New York City (12-15)
North Carolina, at Pinehurst (11-13)
North Dakota, at Bismarck (11-13)
Tennessee, at Memphis (4-6)
South Dakota, at Sioux Falls (4-6)
Utah, at Salt Lake City (21-23)
Vermont, at Burlington (13-15)
Virginia, at Roanoke (4-6)
West Virginia, at Fairmont (18-20)

June

Colorado, at Denver
Maine, at Portland (26-27)
Missouri, at St. Louis (8-10)
New Hampshire, at Sunapee (29-30)

July

Wyoming, at Sheridan (13-14)

September

Southern California, at Los Angeles (21-23)

October

Florida, at Orlando (5-7)

November

Puerto Rico, at Mayaguez

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

STATE BOARDS OF DENTAL EXAMINERS

California, at Los Angeles, June 15, and at San Francisco, May 25. Kenneth I. Nesbitt, 450 McAllister St., San Francisco, Secretary.

Colorado, June 23-27. David J. Tepley, 807 Republic Bldg., Denver, Secretary.

Connecticut, at Hartford, June 23-27. Almond J. Cutting, Southington, Recorder.

Florida, at Jacksonville, June 22-26. H. B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Indiana, at Indianapolis, June 16-19. J. M. Hale, Mt. Vernon, Secretary.

Kentucky, June 2-5. Robert L. Sprau, 970 Baxter Ave., Louisville.

Maine, at Augusta, June 22-24. Alton H. Swett, 192 State St., Portland, Secretary.

Mississippi, at Jackson, June 16. T. Ford Leggett, Laurel, Secretary.

New Jersey, June 29-July 4. John C. Forsyth, 148 W. State St., Trenton, Secretary.

North Dakota, at Fargo, July 14-17. W. E. Cole, Bismarck, Secretary.

Ohio, at Columbus, June 22. Morton H. Jones, 1553½ North Fourth St., Columbus, Secretary.

South Carolina, at Columbia, June 15-17. David Aiken, Winnsboro Bank Bldg., Winnsboro, Secretary.

West Virginia, June 29-July 1. Henry C. Hill, 804 Quarrier St., Charleston, Secretary.

KANSAS STATE DENTAL ASSOCIATION

The sixty-fifth annual session of the Kansas State Dental Association will be held at Memorial Hall, Salina, April 27-29.

FRED A. RICHMOND, *Secretary,*
305 Federal Reserve Life Bldg.,
Kansas City.

MISSISSIPPI DENTAL ASSOCIATION

The Mississippi State Dental Association will hold its sixty-first annual meeting, April 13-15, at the Hotel Greenville, Greenville.

A. H. HENDERSON, D.D.S.

NEW JERSEY STATE DENTAL SOCIETY

The sixty-sixth annual meeting of the New Jersey State Dental Society will be held in the Ambassador Hotel, Atlantic City, April 22-24.

F. K. HEASELTON, *Secretary,*
223 East Hanover St.,
Trenton, N. J.

NEW YORK STATE DENTAL SOCIETY

The annual meeting of the New York State Dental Society will be held at the Waldorf-Astoria Hotel, New York City, May 12-15. Reduced railroad rates on the certificate plan have been arranged for. For further information, apply to

A. P. BURKHART, *Secretary,*
57 E. Genesee St.,
Auburn, N. Y.

SOUTHERN CALIFORNIA DENTAL ASSOCIATION

The next annual meeting of the Southern California Dental Association will be held in the Biltmore Hotel, Los Angeles, September 21-23.

STANLEY RICE, *Secretary,*
Roosevelt Bldg.,
Los Angeles.

WYOMING STATE DENTAL ASSOCIATION

The next annual meeting of the Wyoming State Dental Association will be held at Sheridan, July 13-14.

L. A. FRENCH, *Secretary,*
Thermopolis.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

The next examination to be conducted by the Board of Dental Examiners of California for license to practice dentistry and dental hygiene in California will be held in San Francisco at the Physicians and Surgeons College of Dentistry, commencing May 25, and in Los Angeles in Room 804,

City Hall, commencing June 15. All credentials must be in the office of the secretary at least twenty days prior to the date of the examination. Address all communications to

KENNETH I. NESBITT, *Secretary,*
450 McAllister St.,
San Francisco.

CONNECTICUT DENTAL COMMISSION

The Connecticut Dental Commission will meet in Hartford, June 23-27, for the examination of applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, apply to

ALMOND J. CUTTING, *Recorder,*
Southington.

INDIANA STATE BOARD OF DENTAL EXAMINERS

The next examination of the Indiana State Board of Dental Examiners will be held in Indianapolis, June 16-19. All applications must be in the hands of the secretary not later than ten days before date of the examinations. For applications and other information, address

J. M. HALE, *Secretary,*
Mt. Vernon.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

The next examination of the Kentucky State Board of Dental Examiners will be held June 2-5.

ROBERT L. SPRAU, *Secretary,*
970 Baxter Ave.,
Louisville.

MAINE BOARD OF DENTAL EXAMINERS

The annual meeting of the Maine Board of Dental Examiners will be held at the state house, Augusta, June 22-24. For application blanks and further information, address

ALTON H. SWETT, *Secretary,*
192 State St.,
Portland.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The North Dakota State Board of Dental Examiners will conduct examinations for licenses beginning July 14 at 9 a.m., at the Hotel Gardner, Fargo, and continuing through July 17. Applications must be in the hands of the secretary at least ten days prior to date of examination. For further information and application blanks, apply to

W. E. COLE, *Secretary,*
Bismarck.

OHIO STATE DENTAL BOARD

The June examination of the Ohio State Dental Board will be held at the College of Dentistry, Ohio State University, Columbus, the week beginning June 22. All applications must be in the hands of the secretary at least ten days before the date of examination. For further information, apply to

MORTON H. JONES, *Secretary,*
1553½ North Fourth St.,
Columbus.

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next examination of the South Carolina State Board of Dental Examiners will be held at the State Capitol, Columbia, June 15-17. Applications must be filed thirty days before the examinations.

DAVID AIKEN, *Secretary,*
Winnsboro Bank Bldg.,
Winnsboro, S. C.

WEST VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The West Virginia State Board of Dental Examiners will hold its next annual examination, June 29-July 1. On application to the secretary, a copy of the requirements, rules and instructions, together with application blanks, will be forwarded. Any person desiring to apply as a candidate must file the preliminary application, together with the examination fee of $25, on or before April 15.

HENRY C. HILL, *Secretary,*
804 Quarrier St.,
Charleston.

AMERICAN ACADEMY OF RESTORATIVE DENTISTRY

The American Academy of Restorative Dentistry will meet in San Francisco, Calif., June 27-28.

A. F. SCHOPPER, *Secretary,*
Professional Bldg.,
Kansas City, Mo.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY

The next meeting of the American Society for the Advancement of General Anesthesia in Dentistry will be held March 23 at 8:30 p.m., with dinner at 7 p.m., in the Tower Room, Hotel Montclair, New York City.

H. J. FIELD, *Secretary,*
130 Market St.,
Newark, N. J.

THOMAS P. HINMAN MIDWINTER CLINIC

The 1936 session of the Thomas P. Hinman Midwinter Clinic will be held March 9-10 at the Atlanta Biltmore Hotel, Atlanta, Ga.

CLINTON C. HOWARD, *Chairman,*
Atlanta, Ga.

CLASS OF 1926 SCHOOL OF DENTISTRY COLUMBIA UNIVERSITY

A ten year anniversary dinner for the class of 1926 will be held in May. For further information, address

JOSEPH R. HORN,
580 W. 161st St.,
New York City.

POSTGRADUATE COURSE IN PERIODONTIA, NEW YORK UNIVERSITY COLLEGE OF DENTISTRY

The New York University College of Dentistry will hold its third annual postgraduate course in periodontia for two weeks, or for four weeks, mornings only. Courses are limited to fifteen men. For information and application, address Periodontia Dept., New York University College of Dentistry, 209 E. 23rd St., New York City.

SAMUEL CHARLES MILLER.

ALUMNI ASSOCIATION OF NEW YORK UNIVERSITY COLLEGE OF DENTISTRY

Appeal is made to the alumni of New York University College of Dentistry and to the dental profession to lend their support to the following projects initiated at New York University:

1. New York University Dental Progress Record: Through the Alumni Association, it is proposed to prepare a record of the contributions made by New York University alumni to dental science and dental literature. Alumni are requested to send in to the secretary of the Alumni Association reprints of their published articles for compilation and for the preparation of an official record. Biographies, bibliographies and other records will be especially helpful.

2. School Package Libraries: Reprints on dental articles useful for instructional purposes should be forwarded directly to the New York University College Library, 209 E. 23rd St., New York City. School package libraries are being used in conjunction with the case discussion method of teaching in the oral surgery department.

The name of the oldest living graduate is sought. Records indicate that he is Robert W. Broome, '67. If you know of any alumnus who graduated prior to 1867, communicate with

IRVING SALMAN, *Secretary.*

ONTARIO DENTAL ASSOCIATION

The annual convention of the Ontario Dental Association will be held at the Royal York Hotel, Toronto, May 18-20. Other Canadian dentists and dentists from the United States are welcome.

FRED J. CONBOY, *Secretary,*
86 Bloor St. West,
Toronto.

BRITISH EMPIRE DENTAL MEETING

The British Empire Dental Meeting will be held in London during the last week of July. A large delegation of Ca-

nadian dentists will be in attendance and will leave Montreal July 10.

FRED J. CONBOY, *Chairman,*
Arrangements Committee,
86 Bloor St. West,
Toronto.

F. D. I.

The Dental Congress of the F. D. I. will be held in Vienna, August 2-8. Every one in attendance, no matter which of the Congress languages he speaks, will be able to follow the presentations. The translation service will make it possible for the hearer, by merely pressing a button on the ear-phone attachment at his side to hear the language he desires. Not only theoretical material, but also presentations to meet the needs of those in actual practice, will be given. Interpreters will be on hand at all meetings and in the clinics to simplify interchanges between demonstrators and visitors. Furthermore, opportunity will in this way be afforded to those in attendance from widely separated sections for an exchange of ideas.

A wealth of scientific and industrial material will be shown in the formal exhibitions, including the newest types of equipment on the market.

Vienna, famous for science and art, offers a setting worthy of the Congress. During the hours given over to scientific presentations, a special committee will be occupied in entertaining the families and guests of visitors. Arrangements have been made to visit the many famous sights of the city and for the woman guests in particular to see something of the Vienna famous as a style center and a center of decorative art. After the Congress, there will be opportunity for all to visit the beautiful old landmarks of Vienna, churches, museums, galleries, castles and royal palaces, as well as many nearby spots of interest.

WARNING AGAINST CROOK

J. Leo Ellertson, Caldwell Bldg., Murray, Utah, writes that his state registration card was stolen from his office last summer and that the thief has been using the card all over the country as a means of identification and has been borrowing money from dentists on the face of it. Dr. Ellertson takes this means of clearing his name and protecting his reputation as a dentist in good standing in Utah, and to protect dentists who might be taken in by this crook.

CORRECTION

Dr. Rosenow writes that the formula given at the top of page 39 of the January JOURNAL should read:

$$4 \times \frac{\frac{48.1}{26.5}}{3.79} = 1.72 \text{ microns per second, volt per centimeter.}$$

CHANGE OF ANNUAL MEETING DATES

The Board of Trustees, at its recent meeting in Chicago, adopted a resolution changing the dates of the Seventy-Eighth Annual Session of the American Dental Association.

The meeting will be held in San Francisco, July 13, 14, 15, 16 and 17, 1936.

RECENT BOOKS WORTH BORROWING* OR BUYING†

from the

LIBRARY BUREAU

of the

AMERICAN DENTAL ASSOCIATION

212 E. Superior St., Chicago, Ill.

Adams, C. W.	Your teeth and their care. St. Louis, Mosby, 1932. $1.25.
	Alfred David Lenz system of lost wax casting. New York, National Sculpture Soc., 1933. $2.00.
American Assn. Dental Schools	Course of study in dentistry. Chicago, Amer. Assn. Dental Schools, 1935. $1.00 Paper, $1.50 Cloth.
American Medical Assn., Council on Pharmacy & Chemistry	Glandular physiology and therapy. Chicago, Amer. Med. Assn., 1935. $2.50.
American Medical Assn., Council on Pharmacy & Chemistry	New and nonofficial remedies, 1935. Chicago, Amer. Med. Assn., 1935. $1.50.
American Pharmaceutical Assn., Committee on National Formulary	National formulary. Washington, D. C., Amer. Pharmaceutical Assn., 1935. $5.00.
American Pharmaceutical Assn.	Pharmaceutical recipe book. Baltimore, Amer. Pharmaceutical Assn., 1929. $5.00.
Anderson, G. M.	Orthodontic laboratory manual. St. Louis, Mosby, 1930. $2.00.
Anthony, L. P.	Dental terminology. Chicago, American Dental Assn., 1930. (Free.)
Appleton, J. L. T., Jr.	Bacterial infection with special reference to dental practice. Philadelphia, Lea & Febiger, 1933. $7.00.
Appleton, J. L. T., Jr., & Bryant, C. K.	Laboratory guide in bacteriology. Philadelphia, Lea & Febiger, 1928. $2.75.
Asgis, A. J.	Outline of dental socio-economics. New York, Allied Dental Council, 1934. $1.00.
Bartels, H. A.	Outline of bacteriology. New York, W. A. Broder, 1929. $2.00.
Bartlett, L. W., & Neel, Mildred B.	Compensations in the professions. New York, Association Press, 1933. $2.00.
Beck, Dorothy F.	Cost of equipping a dental office. Chicago, University of Chicago Press, 1932. $1.00.
Berger, Adolph	Principles and technique of oral surgery. Brooklyn, N. Y., Dental Items of Interest, 1927. $7.00.
Berger, Adolph	Principles and technique of the removal of teeth. Brooklyn, N. Y., Dental Items of Interest, 1929. $7.50.
Beust, T. B.	Dental histology and embryology. Philadelphia, Saunders, 1934. $3.00.
Blayney, J. R.	Dental pharmacology and therapeutics. St. Louis, Mosby, 1934. $4.50.
Blunt, Katherine, & Cowan, Ruth	Ultraviolet light and vitamin D in nutrition. Chicago, University of Chicago Press, 1930. $2.50.
Bödecker, C. F.	Elementary histology for dental hygienists. New York, W. A. Broder, 1929. $2.00.

*Books may be *borrowed* by members of the Association for a period of one week after date of receipt; and if not reserved for some one else, the period will be extended on request. A deposit of $2.00 for each volume to be sent at one time should accompany all requests for books. This will be refunded on return of books.

†If you wish to *purchase* books, indicate plainly which books you desire and enclose check with order.

Bogert, L. J.	Nutrition and physical fitness. Philadelphia, Saunders, 1935. $3.00.
Bosworth, H. J.	Dental economics. Chicago, Bosworth Economic Institute, 1932. $3.00.
Bowler, Inez	Elementary manual of dental library practice. Ann Arbor, Univ. of Michigan Press, 1932. $1.50.
Box, H. K.	Necrotic gingivitis. Toronto, University of Toronto Press, 1930. $1.25.
Box, H. K.	Treatment of the periodontal pocket. Toronto, University of Toronto Press, 1928. $1.25.
Bregstein, S. J.	Business conduct of an ethical practice. Brooklyn, N. Y., Dental Items of Interest, 1932. $4.00.
Broderick, F. W.	Dental medicine. St. Louis, Mosby, 1928. $6.00.
Broderick, R. A.	Dental bacteriology. Outlines of dental science. Vol. 2. Edinburgh, Livingstone, 1926. $2.50.
Brothers, E. D.	Dental jurisprudence. St. Louis, Mosby, 1928. $2.25.
Brown, A. J.	Dental metallurgy. Outlines of dental science. Vol. 11. New York, Wood, 1928. $2.50.
Brown, W. L.	Endocrines in general medicine. St. Louis, Mosby, 1927. $3.00.
Buckley, J. P.	Modern dental materia medica, pharmacology and therapeutics. Philadelphia, Blakiston, 1926. $6.00.
Bulleid, Arthur	Textbook of bacteriology for dental students. St. Louis, Mosby, 1927. $4.50.
Bunce, E. W.	Bunce-Kanouse full denture technic. Chicago, Coe Laboratories, Inc., 1929. $1.25.
Bunting, R. W.	A textbook of oral pathology for students and practitioners of dentistry. Philadelphia, Lea & Febiger, 1929. $7.00.
Burchard, H. H., & Inglis, O. E.	Textbook of dental pathology and therapeutics for students and practitioners. Philadelphia, Lea & Febiger, 1926. $7.50.
Burkhart, H. J.	Care of the mouth and teeth. (National Health Series.) New York, Funk & Wagnalls, 1928. $0.30.
Buxton, J. L. D.	Dental pathology. Outlines of dental science. Vol. 7. New York, Wood, 1927. $2.50.
Buxton, J. L. D.	Dental surgery. Outlines of dental science. Vol. 8. New York, Wood, 1927. $2.50.
Cahn, L. R.	Basic principles of general and oral pathology. Brooklyn, N. Y., Dental Items of Interest, 1929. $4.50.
Campbell, Menzies	Those teeth of yours. London, Heinemann, 1931. $1.50.
Casto, T. D.	Questions and answers on pedodontology, with glossary. Philadelphia, Author, 1932. $2.50.
Cattell, Psyche	Dentition as a measure of maturity. Cambridge, Harvard University Press, 1928. $1.00.
Childs, Leslie	Law for the dentist. Philadelphia, S. S. White, 1934. (Subscription premium)
Churchill, H. R.	Human odontography and histology. Philadelphia, Lea & Febiger, 1932. $4.50.
Churchill, H. R.	Meyer's normal histology and histogenesis of the human teeth and associated parts. Philadelphia, Lippincott, 1935. $4.50.
Clark, C. A.	Dental radiography. Outlines of dental science. Vol. 5. New York, Wood, 1926. $2.50.
Cogswell, W. W.	Dental oral surgery. Pittsburgh, Pa., Dental Digest, Inc., 1932. $10.00.
Colyer, J. F., & Sprawson, Evelyn	Dental surgery and pathology. New York, Longmans, 1931. $12.50.
Colyer, Stanley	Chronic infection of the jaws: a short radiological and clinical study. New York, Macmillan, 1926. $3.50.
Committee on Costs of Medical Care	Medical care for the American people. Chicago, Univ. of Chicago Press, 1932. $1.50.
Council on Dental Therapeutics, American Dental Assn.	Accepted dental remedies. Chicago, American Dental Assn., 1935. $1.00.
Dall, William	Ground porcelain inlays. London, Henry Kimpton, 1933. $5.25.

Daukes, S. H.	Medical museum: Modern developments, organization and technical methods based on a new system of visual teaching. London, Wellcome Foundation, Ltd, n.d. (No purchase orders accepted.)
Davis, Adelle	Optimum health. Los Angeles, California Graphic Press, 1935. $2.50.
Davis, M. M.	Paying your sickness bills. Chicago, University of Chicago Press, 1931. $2.50.
Dental Board of the United Kingdom	Four lectures on "general anaesthesia." London, Dental Board of the United Kingdom, 1926. $2.00.
Dental Board of the United Kingdom	Three lectures on "dental alloys." Delivered under the auspices of the Dental Board of the United Kingdom. London, Dental Board of the United Kingdom, 1927. $2.00.
Dewey, Martin, & Anderson, G. M.	Practical orthodontia. St. Louis, Mosby, 1935. $8.50.
Diamond, M.	Dental anatomy: a graphic presentation of tooth forms, etc. New York, Macmillan, 1935. $4.00.
Disraeli, I.	Vincent's disease, pyorrhea and allied subjects. Los Angeles, Calif., Dental Research Pub. Co., 1935. $6.00.
Dorrance, G. M.	Operative story of cleft palate. Philadelphia, Saunders, 1933. $6.50.
Doxtater, L. W.	Procedures in modern crown and bridge-work. Brooklyn, N. Y., Dental Items of Interest, 1931. $8.00.
Endleman, Julio	Special dental pathology; a treatise for students and practitioners. St. Louis, Mosby, 1927. $7.00.
Ennis, L. M.	Dental roentgenology. Philadelphia, Lea & Febiger, 1931. $6.50.
Farkasch, O.	Dilemmas of dentistry. New York, Dodd Bros., 1931. $3.50.
Federspiel, M. N.	Harelip and cleft palate. St. Louis, Mosby, 1927. $5.00.
Felcher, F. R.	Art of porcelain in dentistry. St. Louis, Mosby, 1932. $9.00.
Feldman, M. H.	Manual of exodontia. Philadelphia, Lea & Febiger, 1930. $3.50.
Ferguson, H. W.	Child's book of the teeth. Yonkers-on-Hudson, World Book Co., 1932. $0.68.
Fine, Samuel	Principles and practice of dental assistant. Worcester, Mass., Hamilton Pub. Co., 1931. $2.50.
Fischer, Guido	Local anesthesia in dentistry. Philadelphia, Lea & Febiger, 1933. $4.00.
Fish, E. W.	Experimental investigation of enamel, dentine and the dental pulp. London, John Bale, Sons & Danielsson, Ltd., 1933.
Fish, E. W.	Principles of full denture prosthesis. London, John Bale, 1933. $4.00.
Fones, A. C.	Mouth hygiene; a textbook for dental hygienists. Philadelphia, Lea & Febiger, 1934. $5.00.
Fones, A. C.	Preventive dentistry. Philadelphia, Lea & Febiger, 1925. $2.75.
Foote, J. S.	Bone as a measure of development: When and how we acquired our teeth. Chicago, American Dental Association, 1928. $4.00.
Frahm, F. W.	Principles and technics of full denture construction. Brooklyn, N. Y., Dental Items of Interest, 1934. $7.00.
Franzen, Raymond	Public health aspects of dental decay in children. New York, American Child Health Assn., 1930. $1.25.
Gies, W. J.	Dental education in the United States and Canada. New York, Carnegie Foundation, 1926. (Free.)
Gillett, H. W., & Irving, A. J.	Gold inlays by the indirect system. Brooklyn, N. Y., Dental Items of Interest, 1932. $8.00.
Goepp, R. M.	Dental state board questions and answers. Philadelphia, Saunders, 1928. $4.50.
Goslee, H. J.	Principles and practice of crown and bridge-work. Brooklyn, N. Y., Dental Items of Interest, 1926. $7.50.
Gottlieb, B., & Orban, B.	Die veränderungen der gewebe bei übermässiger beanspruchung der zähne. Leipzig, Georg Thieme, 1931. Unbound, $6.50. Bound, $7.00.
Graves, Lulu G.	Foods in health and disease. New York, Macmillan, 1932. $3.50.
Greenfield, A. L.	Interpretation of dental radiograms. Rochester, N. Y., Ritter Dental Mfg. Co., 1926. $2.50.
Gregory, W. K.	Our face from fish to man. New York, Putnam, 1929. $4.50.
Gwathmey, J. T.	Textbook of anesthesia. New York, Macmillan, 1929. $7.50.

Gwinn, C. D.	Textbook of exodontia. Philadelphia, Lea & Febiger, 1927. $2.75.
Gysi, Alfred	Special teeth for cross-bite cases. New York, Dentists' Supply Co., 1928. (Pamphlet.) (No purchase orders accepted.)
Hackh, I. W. D.	Chemical reactions and their equations. Philadelphia, Blakiston, 1928. $2.00.
Haden, R. L.	Dental infection and systemic disease. Philadelphia, Lea & Febiger, 1928. $2.50.
Hall, E. M.	Pulpless tooth problems. Detroit, Mich., Detroit Dental Manufacturing Co., 1930.
Hanau, R. I.	Dental engineering. Buffalo, N. Y., Author, 1926. (No purchase orders accepted.)
Hanau, R. I.	Hanau intraoral method vs. Gysi extraoral method. Buffalo, N. Y., Author, 1927. (No purchase orders accepted.)
Hanke, M. T.	Diet and dental health. Chicago, Univ. of Chicago Press, 1933. $4.00.
Harder, O. E.	Modern dental metallography. Minneapolis, Minn., Burgess-Roseberry Co., 1930. $3.75.
Harris, L. J.	Vitamins in theory and practice. New York, Macmillan, 1935. $3.00.
Harrow, Benjamin, & Sherwin, C. P.	Textbook of biochemistry. Philadelphia, Saunders, 1935. $6.00.
Hartman, L. L.	Teeth and the mouth. New York, Appleton, 1927. $1.50.
Hayes, L. V.	Clinical diagnosis of mouth diseases. Brooklyn, N. Y., Dental Items of Interest, 1935. $7.00.
Head, Joseph	Everyday mouth hygiene. Philadelphia, Saunders, 1925. $1.00.
Hedstrom, Gustav	Gangrene of dental pulp and its treatment. Stockholm, Sweden, Isaac Marcus, 1927. (No purchase orders accepted.)
Headridge, Davis, & Gibson, S. K.	Dental anatomy, human and comparative. Outlines of dental science. Vol. 6. New York, Wood, 1928. $2.50.
Herbst, Emil, & Apffelsteadt, Max	Atlas and grundriss der missbildungen der kiefer and zähne. München, J. F. Lehmanns, 1928. (No purchase orders accepted.)
Hertzler, E.	Technic of local anesthesia. St. Louis, Mosby, 1925. $5.50.
Hess, Walter, & Zurcher, Ernst	Anatomy of the root-canals of the teeth. New York, Wood, 1925. $5.50.
Hewer, C. L.	Recent advances in anaesthesia and analgesia. Philadelphia, Blakiston, 1932. $3.50.
Hildebrand, G. Y.	Studies in masticatory movements of human lower jaw. Berlin, Gruyter, 1931. (No purchase orders accepted.)
Hodgen, J. D.	Practical dental metallurgy. St. Louis, Mosby, 1932. $3.75.
Hogeboom, F. E.	Practical pedodontia or juvenile operative dentistry and public health dentistry. St. Louis, Mosby, 1933. $6.50.
Hoke, C. M.	Testing precious metals: gold, silver, palladium, platinum; identifying, buying, selling. New York, Jewelers Technical Advice Co., 1935. $1.00.
Holliday, Houghton	Dental radiology handbook. New York, Macmillan, 1935. $2.00.
Hyatt, T. P.	Hygiene of mouth and teeth. Brooklyn, N. Y., Brooklyn Dental Pub. Co., 1929. $1.00.
Hyatt, T. P.	Prophylactic odontotomy: A practical and simple procedure for the prevention of caries in pit and fissure cavities. New York, Macmillan, 1933. $1.50.
Ivy, R. H., & Curtis, Lawrence	Fractures of the jaws. Philadelphia, Lea & Febiger, 1931. $4.50.
Jamieson, J. D. H.	Operative dentistry. Outlines of dental science. Vol. 9. New York, Wood, 1927. $2.50.
Jerman, E. C.	Modern x-ray technic. St. Paul, Bruce Pub. Co., 1928. $5.50.
Jordan, E. O.	Textbook of general bacteriology. Philadelphia, Saunders, 1935. $6.00.
Jordan, M. Evangeline	Operative dentistry for children. Brooklyn, N. Y., Dental Items of Interest, 1927. $5.00.
Kanner, Leo	Folklore of the teeth. New York, Macmillan, 1928. $4.00.
Kells, C. E.	Dentists' own book, including a complete bookkeeping and recording system. St. Louis, Mosby, 1925. $7.50.

Kells, C. E.	Three score years and nine. New Orleans, The Author, 1926. $8.00.
Kennedy, Edward	Partial denture construction. Brooklyn, N. Y., Dental Items of Interest, 1928. $7.50.
Kent, E. N.	Business side of dentistry. St. Louis, Mosby, 1929. $5.00.
Knapp, K. W.	Manual of fixed bridgework. New York, New York Univ. Press, 1935. $3.00.
Korkhaus, Gustav	Moderne orthodontische therapie. Berlin, Meusser, 1932.
Kronfeld, Rudolf	Histopathology of the teeth and their surrounding structures. Philadelphia, Lea & Febiger, 1933. $7.00.
Kuttler, Yury	Mis investigaciones sobre la denticion en 15,240 ninos y 782 adultos habiendo hecho 28,557 examenes. Mexico, D. F., Facultad Odontologica de la Universidad Nacional Autonoma de Mexico, 1933.
Lee, R. I., & Jones, L. W.	Fundamentals of good medical care. Chicago, Univ. Chicago Press, 1933. $2.50.
LeGro, A. L.	Ceramics in dentistry. Brooklyn, N. Y., Dental Items of Interest, 1926. $7.50.
Leriche, R., & Policard, A.	Normal and pathological physiology of bone. St. Louis, Mosby, 1928. $5.00.
Leuck, Miriam S.	Study of dental clinics in the United States: 1930. Chicago, University of Chicago Press, 1932. $1.00.
Leuck, Miriam S.	Further study of dental clinics in the United States. Chicago, University of Chicago Press, 1932. $1.50.
Leven, Maurice, & Beck, Dorothy F.	Practice of dentistry and incomes of dentists in twenty states: 1929. Chicago, University of Chicago Press, 1932. $2.00.
Lindsay, Lilian	Short history of dentistry. London, John Bale, 1933. $1.50.
Livingston, Alexander	Dental histology. Outlines of dental science. Vol. 10. New York, Wood, 1928. $2.50.
Lloyd-Williams, E.	Dental mechanics: a manual for students and junior practitioners. London, Bale, 1931. $2.00.
Logan, J. D.	Dental prosthetics. Outline of dental science. Vol. 4. Edinburgh, Livingstone, 1926. $2.50.
Lucas, H. A.	Medicine for dental students. Baltimore, Wm. Wood & Co., 1933. $2.75.
MacNevin, M. G., & Vaughan, H. S.	Mouth infections and their relation to systemic diseases. New York, Joseph Purcell Memorial, 1933. $4.00.
Macphie, G. G.	Studies in aetiology of dental caries. London, John Bale, 1935. $2.50.
Maliniak, J. W.	Sculpture in the living: rebuilding face and form by plastic surgery. New York, Lancet Press, 1934. $3.00.
Margolis, H. M.	Conquering arthritis. New York, Macmillan, 1932. $2.00.
Marriott, W. M.	Infant nutrition; a textbook of infant feeding for students and practitioners of medicine. St. Louis, Mosby, 1935. $4.50.
Marsden, P. H.	Dental materia medica. Outlines of dental science. Vol. 3. Edinburgh, Livingstone, 1926. $2.50.
Marshall, J. A.	Diseases of the teeth; their diagnosis and treatment. Philadelphia, Lea & Febiger, 1926. $4.50.
Maximow, A. A., & Bloom, Wm.	Textbook of histology. Philadelphia, Saunders, 1934. $7.00.
McBride, W. C.	Juvenile dentistry. Philadelphia, Lea & Febiger, 1932. $2.75.
McCaw, Emma J.	Dental assistant. St. Louis, Mosby, 1926. $1.50.
McCollum, E. V., & Becker, Ernestine	Food, nutrition and health. Baltimore, Authors, 1933. $1.50.
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